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PHYSICS WITHOUT APPARATUS.

The notions that we possess in regard to gravitation and weight, and experiments relative to the fall of bodies, may be easily demonstrated by just such simple articles as we have at hand. Here is a cent, and a piece of paper which I have cut in the form of a piece of money. Placing these alongside of each other, I let them fall. The cent reaches the floor much before the paper. The result is not contrary to the laws of gravity, because we must take into consideration the presence of the air and the different resistances that it offers to the two bodies on account of their different densities. Now I place the piece of paper on the upper surface of the cent, and allow the latter to fall in its horizontal position. Both objects reach the floor at the same instant, because the paper in contact with the coin was preserved from the action of the air during its fall. This experiment is so well known that we will not dwell long upon it, but it will be seen that it is capable of giving us some ideas in regard to the phenomena connected with the fall of bodies.

We are thus led next to study centrifugal force. To show this we shall have recourse simply to a tumbler of water which we place upon a disk of cardboard provided with strings after the manner of a sling. Now on swinging the tumbler around in the air (Fig. 1), we find that the water does not spill out, even when the glass is in a vertical position.

The principles of hydrostatics may be explained just as easily. Prof. Aimé Schuster has pointed out to us how the principle of Archimedes may be shown in a very simple manner. Take any object whatever, no matter how irregular its form—say a stone for instance—attach it to a thread, and immerse it in a tumbler filled with water up to its edge. The water runs over, and the volume which flows out is

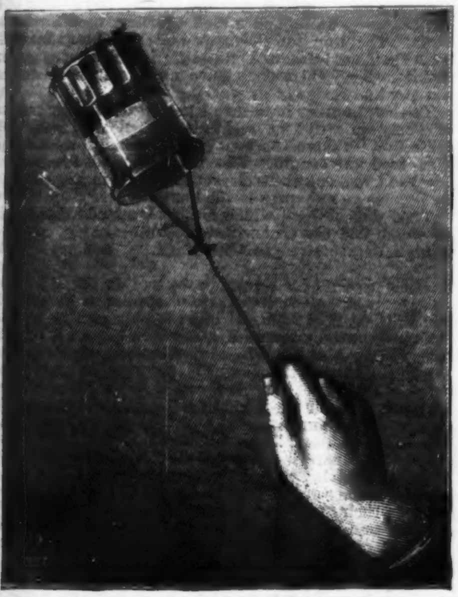


Fig. 1.—WATER HELD IN A TUMBLER BY CENTRIFUGAL FORCE.

necessarily equal to that of the stone. The partially empty glass is now to be wiped dry and placed upon one of the pans of a pair of scales, and beneath it is suspended the stone. The scales are then to be balanced by placing shot in the other pan. This done, take a glass full of water and immerse in it the stone which is suspended beneath the scale pan. The equilibrium will at once be broken, and to restore it it will be necessary to fill up the tumbler again which is on the scale pan; in other words to pour into the tumbler a volume of water which is exactly equal to that of the stone. If it be desired to understand the principles relating to communicating vessels, fountains, artesian wells, etc., it may be demonstrated by means of two funnels, the necks of which are connected with each other by means of rubber tubing. Upon pouring a sufficient amount of water into one of the funnels placed at a higher level than the other, the water will be seen to overflow from the lower one.

A disk of mica and a lamp chimney will permit us to understand the nature of the upward pressure exercised by liquids. I close one of the ends of the chimney by a thin disk of mica kept in place by a string, and plunge the closed tube in a vessel of water. The disk is kept in place by the upward pressure of the liquid. To separate it from the aperture, it is only necessary to fill the tube with water up to the level of the external liquid. (Fig. 2.) The external pressure which is exercised on the plate of mica is then equal (like that which is exercised within) to the weight of a column of water having for base the surface of the tube's aperture, and for height the distance from the disk to the level of the liquid. The peculiar phenomena that are manifested when we observe the level of liquids in very narrow spaces, as in small glass tubes, or between two plates in juxtaposition—capillary phenomena—require no special apparatus to show them. Fig. 3 represents a pretty experiment in physics relating to these phenomena. A goblet is filled up to the very edge with water, care being taken to have the surface concave. A pile of silver dollars

Fig. 2.—DEMONSTRATION OF THE UPWARD PRESSURE EXERCISED BY LIQUIDS.

is placed alongside of it. If the audience be asked how many coins it is possible to drop into the glass without causing the water to overflow, nearly every one unacquainted with the experiment will answer that it will take but one or two. The fact is, however, that it will take as many as ten or twelve. When the coins are dropped into the water carefully and with a steady hand (Fig. 3), the surface of the liquid is seen to become more and more convex, and it is really astonishing what a degree of convexity it will reach before overflowing. The experiments performed thus in regard to gravity and hydrostatics, might be considerably extended and form the basis of a real course. And it might be the same for heat, light, electricity, acoustics, and all branches of physics. To close our second chapter, here is a very interesting experiment in acoustics, and which gives a very good idea of the transmission of sounds through solid bodies. A silver spoon is attached to a thread, and the two ends of the latter are thrust into the ears as shown in Fig. 4. This done, the spoon is caused to swing so as to touch the edge of the table. The transmission of the sound is so intense that we might imagine we heard the bell of a

Fig. 3.—EXPERIMENT ON THE CONVEXITY OF LIQUID SURFACES.

cathedral. This experiment explains perfectly the string telephone, another very simple apparatus which any one can construct for himself, and which is so well known that we think it unnecessary to describe it.

THE RADIOGRAPH.

At a recent meeting of the Manchester Literary and Philosophical Society, January 13, 1880, J. P. Joule, D.C.L., LL.D., F.R.S., etc., President in the chair, a paper was read on "The Radiograph," by D. Winstanley, F.R.A.S.

The instrument in question places a lead pencil on a sheet of paper, and writes down therewith when, and for how long, the sun may chance to shine, but it makes no record of the intensity of his rays. I will now ask your attention to the description of another and much more perfect apparatus, one which continuously records the intensity of thermal radiation to which it is exposed. This instrument I have called the "radiograph." It consists essentially as follows: A differential thermometer of which the stem is circularly curved is mounted concentrically upon a wheel of brass in a groove cut with that object for its end. This wheel is supported with its plane in a perpendicular position by a knife edge of hardened steel which passes through its geometric center and rests on agate planes. The tube of the thermometer is partly filled with mercury—preferably through half its curve—and for the reason given in my description of the simple sunshine recorder, to which I have alluded, a little sulphuric acid is introduced as well. If we now arrange it that the center of gravity of the solid portion of the system here described shall be below the surface of the planes on which it turns (and the apparatus is provided with adjustments by means of which the point in question can be moved), it is clear that the arrangement may be made to swing in pendulous oscillations, notwithstanding the presence of the liquids it contains, for these remain substantially at rest while the tube which holds them does, in fact, slide over them (and with very little friction too) in swinging to

Fig. 4.—CONDUCTIVITY OF SOUND BY SOLIDS.

and fro through arcs of the circles of which its parts are curves.

Both bulbs of the thermometer are closed. It is obvious, therefore, that the tension of the air or gas which they contain will be uninfluenced by the barometric variations of the outer air, the temperature of which latter being experienced equally in each bulb will also leave the equilibrium of the apparatus undisturbed. When, however, one bulb is more heated than the other, the air contained therein will press more strongly on the heavy liquid piston in the tube, and wheel the swinging portion of the system round until a fresh position of equilibrium is gained, and this will be (providing that the center of gravity of the system has previously been made coincident with the point on which it turns) when the tension of the gases is equal in both bulbs. In fact, in so far as now described, the instrument is a differential thermometer, and is that alone, differing in this from Leslie's, that it is a solid and accessible portion of the thing which moves, and not the liquid it contains. When, however, one of the bulbs is blacked and the other one is silvered or left clear, the apparatus becomes a "radiometer" in the proper meaning of the term, that is to say, a measurer of the thermal radiance to which it is exposed, and the intensity of which it indicates by variations in the angular positions of a needle prolonged from one or other of the radii of the wheel.

It is only needful now to so arrange it that this needle shall make a tracing of its curves on a cylinder driven by clockwork at an even speed, and the "radiograph" is complete.

Concerning the actual instrument I use, its wheel is 7·3 inches in diameter, and the weight thereof a trifle more than two pounds. The other portions of the apparatus are of the same dimensional proportions as are indicated in the sketch. Of course some delicate method of recording

has to be employed, and I have thus far used the smoked paper process so much adopted in the observatories of France. In this way the "radiograms" which illustrate this paper were obtained.

When using the instrument to record the radiance of the sun I have hitherto exposed it in a box of copper surmounted by a dome of glass into which the bulbs of the thermometer project. The line which joins them is in the plane of the meridian of the place, and the black bulb to the north. The box itself is supported at an elevation of four feet or thereabouts upon a stand of wood, the legs of which are firmly embedded in the ground. The stand itself is located at the extremity of a garden which overlooks a valley and the sea. A small window in the box permits the movements of the train to be seen, and the promptness with which the apparatus acts to be observed. If a cloud "no bigger than a man's hand," and "light as a feather" in its texture, floats before the sun, and occupies but three or four seconds in its transit, its presence, the duration of its passage, and the degree of thermal obscuration it effects are at once set down.

The cylinder of the radiograph passes over a space of 0·875 of an inch per hour, a somewhat open range, but, as will be seen on reference to the tracings, the needle often moves for some considerable distance in both directions along the same thin line, thereby showing a practical instantaneity of action under very ordinary thermal changes in the radiance from the sky. The influence of the sun's rays at daybreak is almost always shown, for some minutes at any rate, before the sun himself is seen, and occasionally it would seem even for hours before his time to rise.

It is not, however, now my purpose to dwell upon the interesting changes which take place in the intensity of the thermal radiance from the sky, my present object being to describe an instrument by means of which they may be recorded or observed. Doubtless in several of its details the "radiograph" may be improved, notably in the condition of its bulbs, and it would unquestionably be better if it computed for itself the areas included by its curves. This, I dare say, I shall presently enable it to do. Meanwhile, as a recorder of the duration and intensity of radiant heat, the instrument, so far as I have seen, is the only one whose readings are uninfluenced by the temperature or the pressure of the air.

DETERMINATIONS OF LONGITUDE.

AT the recent meeting of the National Academy of Science, at Washington, Lieutenant Commander F. M. Green, U. S. Navy, read an interesting report on the progress made by the United States Hydrographic Office in establishing, by the use of telegraph cables, a general system of secondary meridians of longitude. Geographers and chart-makers have been and are still greatly embarrassed by the difficulty of harmonizing the different values assigned to the longitudes of nearly all points on the earth's surface outside of the United States and Europe. The English Hydrographic Office has selected 50 points at intervals, and assigned to each an arbitrary longitude, and on these positions their charts are constructed, but they do not harmonize, and many of them vary widely from the truth. The French Government has sought to establish a similar set of positions by observations of moon culminations, but the results are not satisfactory, and experts are agreed that where telegraphic communication exists, no method of determining longitudes equals for accuracy and simplicity that known as the American method, which consists in comparing, by means of the electric telegraph, two time-pieces, one situated at each end of the line and the errors of which on local time are determined by astronomical observations. In this way differences of longitude are first measured from the initial meridian, and then from the places so determined, step by step. In 1873 the United States Hydrographic Office commenced this work, measuring step by step from Key West through the West India Islands to Panama on the west and Port Spain on the east, fitting out two parties, each with portable observatory, transit instrument (with zenith telescope attachment), break-circuit chronometers, and telegraph instruments.

Thirteen positions were exactly established in this way in 1874 and 1875. In 1877 and 1878 a similar chain of measurements was extended by Lieutenant Commanders F. M. Green and C. H. Davis, United States Navy, from Greenwich Observatory, by way of Lisbon, Madeira, Porto Grande, Peruambuco, Bahia, Rio de Janeiro, and Montevideo, to Buenos Ayres, there connecting with the chain of exact measurements made by Dr. B. A. Gould, at Cordova, extending to Ascension, Santiago, and Valparaiso. An interesting feature of this measurement was the demonstration that the Royal Observatory at Lisbon, and, indeed, the whole coast of Portugal, should be laid down two miles further to the westward than has before been done. Altogether, 21 positions on foreign coasts not heretofore exactly established have been determined with all possible accuracy, but a great deal remains to be done. The Russians have carried a measurement by similar means across Siberia, terminating at Wladiwostok, and the engineers of the Great Trigonometrical Survey of India have measured from Greenwich, through submarine cables, to Bombay and Madras. The Chief of the Bureau of Navigation, Commodore W. D. Whiting, is very desirous to join the points of Wladiwostok and Madras by a measurement through the cables along the coasts of Japan, China, and Malaysia. This will give ten more exact points. Another important piece of work will be to measure from the Coast Survey station at Brownsville, Texas, by the lines of the new Mexican Cable Company, to Tampico and Vera Cruz; then across the Isthmus of Tehuantepec, along the coast of Central America, to Panama and Guayaquil. By this measurement, nine or ten more secondary meridians would be added to the list, and, as soon as the war ceases between Peru and Chili, ten more can be added by the use of the line along the west coast of South America. A cable also connects the general East India system of telegraph lines with Zanzibar and South Africa. This measurement will probably soon be made by the authorities of the observatory at the Cape of Good Hope, and upon its result will depend the longitudes of a great part of the east and west coasts of Africa, as well as the numerous islands of the Indian Ocean. These meridians once established, subsidiary chronometric measurement from them becomes an easy matter, and the present discordance between different lists of geographical positions will no longer exist.

A CHICKEN fancier says that he stuck court plaster over an egg found broken in the nest after the hen had been sitting a week, and in due time gave it a chicken as sprightly as any of the brood.

[Continued from SUPPLEMENT, No. 231, page 3674.]

THE NORTH-EAST PASSAGE.

NARRATIVE OF CAPTAIN PALANDER, SWEDISH ROYAL NAVY, COMMANDER OF THE EXPLORING VESSEL.

YOKOHAMA, Sept. 12, 1879.

The season of the year was now far advanced, and being acquainted with the sudden transition from summer to winter in the Arctic regions, we knew that at any time winter might set in in earnest, and make all further progress impossible. From this time the temperature was invariably below zero.

On the evening of the 18th, during the darkness, while forcing a belt of ground ice, we touched the bottom; but the following morning, at 4 o'clock, we were again on the way quite uninjured.

On the 19th of September we succeeded in pushing our way forward about fifty miles. On the 20th, 21st, 22d, 23d, 24th, and 25th, our combat with the ice was continued, and we made very little progress. On the 26th we rounded Cape Wankarem, where we found tolerably clear water, caused by the rapidly flowing river of the same name. The same evening we also doubled Cape Onman, and on the following day we went right across Koliutchin Bay, passing close to Koliutchin Island. In the evening we moored close west of the north-east point of the bay.

The 28th of September was a cold but clear morning. The sea had, during the night, been covered with a layer of ice one to two inches thick. We rounded the point, but afterward could only push our way forward about four miles when we had again to moor. I little thought on the morning of that day this would be the last time during 1878 that our vessel would be on the onward move. We had before encountered stronger ice, and fought against greater difficulties; and now to reach Behring Strait we had only 120 miles to accomplish of the 4,000 which constitute the length of the Old World's northern shores.

At first no one would realize that we might be compelled to pass the winter here, but hoped for a change in the weather, and for a storm which would break and disperse the ice. But instead of this, however, the cold increased, and the new ice which connected the drift floes daily became stronger, and the weather remained quite calm. Here we were to spend the winter—here where the American whalers find yearly quite navigable water several weeks later than the 28th of September. The situation of our wintering station was, according to observations, lat. N. 67° 7', and long. W. 173° 24', 4,500 feet out from a flat sandy beach, entirely unprotected from all winds excepting the south. Between the Vega and the shore were two sand banks, the nearest having ten feet of water, the other still less.

At the outset of the expedition my impression was that the greatest difficulties in making the North-east Passage would be experienced in rounding Cape Tchelyuskin and possibly the coasts on both sides of same—namely, from Taimyr Island to Khatanga Bay. All available accounts, however, agree that the coast between Cape Yakan or North Cape and Behring Strait is quite free of ice during the summer and autumn. When we had successfully rounded Cape Tchelyuskin, and had passed Cape Yakan so early as the 7th of September (therefore in good time), we calculated with certainty upon being able to pass Behring Strait the same year. On the contrary, our greatest difficulties commenced at Cape Yakan, and instead of diminishing in the same degree, the farther we proceeded eastward, they became still greater and greater. We have good cause to infer that the condition of ice in 1878 was peculiarly unfavorable, and that, under ordinary circumstances, we should have reached Behring Strait without difficulty, and immediately thereafter the Pacific Ocean. We had now to content ourselves with having arrived at the entrance to Behring Strait during the first summer. As proof of the condition of these waters in other years, I quote the following from statistics supplied by the United States Admiralty:

1st. On the 21st September, 1867, the American bark Massachusetts, Cape Williams, reached lat. N. 74° 30', long. W. 173° (the same longitude as our winter station), from whence no ice could be discovered round the compass. Captain Williams, an old whaler, and a man well acquainted with these waters, adds further, in his report, that he is convinced that no ice exists from the middle of August until the 1st of October south of lat. 70°, and west of long. W. 170°, and that there is seldom a year when it is not possible during the month of September to sail in navigable water between North Cape and Behring Strait.

2d, Captain Niebaum, also an experienced ice navigator, relates that Behring Strait is open till the first days of November, and that he on two occasions sailed through that Strait as late as the 22d of October.

3d, In the year 1869, the bark Navy anchored at Koliutchin Island on the 8th of October, and sailed from thence to Behring Strait on the 10th of the same month. No ice was then to be seen.

4th, In 1867, the bark Nile, Captain Long, reached lat. N. 70° 41', long. E. 170° 20', coming from and returning to Behring Strait.

5th, The same year the bark Monticello went 150' further west. Annually many small American coasting traders sail along the shores of Siberia even farther west, and carry on a bartering trade with the natives. We had evidence of this in the fact, that among all the natives we have met, numbering more than a thousand, we have not met one who did not know a few English words.

More than fifty large vessels engaged in sealing and whaling north of Behring Strait swarm thereabout in all directions.

The natives inhabiting the coast of Siberia between Cape Shelagskoi and the southern part of Behring Strait are called Tchuktchis, as already mentioned. Their number is estimated to be about 3,000, including a nomadic tribe called the Rein-Tchuktchis, who subsist by keeping reindeer herds. These form a link between their brethren on the coast and the inland tribes of Siberia, to the latter of whom they dispose of their goods, consisting of seal and walrus hides, walrus teeth, etc., which they receive from the country population in exchange for reindeer hides.

The coast population live in villages numbering from three to twenty tents, spread along the coast as near the shore as possible, and at a few miles' distance from each other.

The Tchuktchis are divided into two sections, each with its respective chief. The eastern population have for their chief Menka, who resides at Markowa on the Anadyr River. The western, again, are under the chief Amra Urgin, who resides in the vicinity of Kolyma River.

The tent of the coast Tchuktchis consists of a peculiar and cleverly constructed frame of wood, the material for which is obtained from drift logs, with which the shore is plentifully strewed. This is covered with a number of seal and walrus hides carefully sewn together. Inside the tent, and right before the entrance, is a smaller cubiform tent, made of reindeer skins, and used as the sleeping chamber. During the cold season it is heated by blubber lamps. Even during severe cold the atmosphere within this tent is so heated that the natives who occupy it, without distinction of sex or age, lie almost nude. The dimensions of the tent depend upon the number of the family. In each tent generally dwells only one family, in which are included the sisters and brothers of the married couple before they settle for themselves.

The Tchuktchis, the children of nature in the Arctic regions, fostered among ice, snow, and cold, familiarized with bloody scenes in the seal, whale, and walrus hunt, without any of the influences of civilization, are, notwithstanding, a good natured, friendly, hospitable, and honest people.

Although the Vega during the long winter was daily visited by at least twenty natives, it was only on two or three occasions that they were found guilty of dishonestly appropriating anything, and these thefts were of the most trifling description.

The Tchuktchis are a people of small stature, although among them may be found perfect giants; as, for instance, a women whom we saw 6 feet 3 inches tall. Their complexion is sallow, the men's being usually darker than that of the women. Occasionally, however, one may see, especially among the women, a complexion as fair and clear as that of the inhabitants of Northern Europe. The eyes are black, and often set oblique like the Chinese. The hair, which is coal black, is worn by the men cut quite short; while the women allow it to grow freely, part it in the middle of the brow, and wear it in plaits of twelve to eighteen inches long, which hang down at each ear. They also wear a lock combed down and cut across which covers half of the forehead. The men also use a similar lock, and sometimes a long tuft at the crown of the head. This tuft is worn, so far as I could learn, only by chiefs.

Their clothing is made principally of reindeer skin, and consists of a *pesk* or blouse reaching to the knees, with an opening at the top just sufficient for the head to pass through. In addition, the men have tight-fitting trowsers of reindeer skin, which are tucked down into boots of the same material, the latter with soles of walrus hide. The women also wear trowsers, but those are wide, ending immediately below the knee, where they are similarly tucked into the boots.

In the outer clothing the hairy side of the skin is always to the exterior; but, on the contrary, the hairy side of those articles worn next the body during the cold season is turned inward. A close-fitting hood of reindeer skin and mittens of the same material complete their dress. In this costume they defy any kind of weather. Often so clad, night after night, even in the most severe cold, they pursue their seal-fishing miles away from the shore without any other protection from the icy winds.

The weapons of the Tchuktchis consist of a bow and arrows, a spear—which, like the arrows, has a point of iron or of bone—a knife, and a kind of sling, used for catching birds. The iron for the arrow and spear heads is obtained from the Americans and Russians in their bartering transactions. They themselves have no iron at their command, nor any knowledge of its working.

To their hunting implements belong the sealing net, made of finely-cut strips of seal hide, netted with a three-inch mesh. With these the young seals, which form their principal food, are caught. The net is extended between two blocks of ice, and the seals get entangled in its meshes, and so become an easy prey to the hunters.

Their dog sledges, which are constructed of thin pieces of wood, tied together with strips of seal hide, combine to a high degree strength with elasticity, and are singularly light.

Their mode of conveyance by sea is the *kajak*, or the "large boat." The kajak, quite similar to the Greenland kajak, is covered with seal hide; it only carries one man, who propels it by means of a common kajak oar or paddle. The "large boat," which also resembles the boat used in Greenland under the name of the "women's boat," is upward of thirty feet long. It is rowed by six to ten men, with common oars, or *pagajas*. This boat is constructed of a thin wooden frame, covered with seal and walrus hides. It has a flat bottom, from which its sides project at right angles. Its carrying capacity is very great. I have seen such boats having thirty people on board.

The hammer of the Tchuktchis consists of a stone tied to a stick; their spade, of a walrus's shoulder-blade fastened to a stick; and in the same manner they contrive other necessary domestic utensils and tools. They are perfect masters in the art of joining by means of thongs of seal hide.

The principal food of the natives consists of seal flesh and blubber, in addition to which they use feathered game, bear and reindeer flesh, when such can be obtained. The roots of certain shore plants, also willow leaves, ranunculus, saxifrage, etc., enter pretty largely into their diet. The leaves are collected in the latter end of summer, pressed, and consumed during the winter; and in these they are provided with a powerful antiscorbutic. During the winter, when getting short of other provisions, the bones of seals and walruses caught during summer are crushed, and prepared in the form of a broth or soup, which is consumed by both men and dogs. Of the latter there are a great number in every village, which are chiefly employed in conveying their owners by sledge from one place to another. Although these dogs are not large, three or four of them can with ease carry a man long distances. When the Tchuktchis undertakes long journeys of 300 to 500 miles, he often has as many as eighteen dogs harnessed to his sledge, with which he is able to accomplish seventy to eighty miles a day.

During the first half of the winter we were daily visited by twenty to thirty natives, who got any food the crew might have left. Besides this, they received a considerable quantity of bread from the ship's stores. They made themselves useful in several small ways, such as sawing wood, carrying ice, etc., etc. In the beginning of February, when their provisions began to run short, they all removed from Pitlekai (the nearest village to us) to another village farther east, called Naskai, where they raised temporary tents, and carried on seal fishing in the open water to be found in the vicinity. About this time the natives made a great haul, allowing to each tent twenty-five to fifty young seals. Besides seals, they got in the same vicinity a good catch of a fish resembling cod.

At first we had some difficulty in holding communication with the natives, but we soon picked up a sufficient number of words to make ourselves intelligible. Lieutenant Nordqvist, who paid special attention to the language of the Tchuktchis, ultimately became tolerably familiar with it. I here give some specimens: *anka*, sea; *atleatle*, snow; *eek*, fire; *ergatik*, to-morrow; *ellongat*, to-day; *ee*, yes; *jaranga*,

tent; *jo*, wind; *kau kau*, food; *koy koy*, cold; *mimil*, water; *murgin*, my; *oinga*, no, nothing; *oumko*, bear; *ounkri*, ptarmigan; *outout*, wood; *rurka*, walrus; *tintin*, ice; *tirkir*, sun; *tschagurgin*, go; *tschepiska*, sleep; *tschopak*, dog; *tschopagat*, drive with dogs; *turgin*, yours.

After the 28th of September, the day on which our further progress was completely arrested, we still cherished a hope of getting free, and accomplishing the remaining little distance to Behring Strait the same autumn; but gradually this hope died out, and we began in earnest to think of the impending winter. With regard to the ship there was really nothing to do, as all preparations to resist an Arctic winter had already been made.

We fitted up the winter tent, the top rope of which was fixed midway up the masts, and from thence extended to the bulwarks. That the daylight might not be shut out from the saloon, the tent was not erected over the quarter-deck. The deck was covered with six inches of snow, which aided considerably in the exclusion of the cold from that quarter. The engine was kept during the whole winter in such a condition that at three hours' notice it could be set in motion.

The vessel was heated by means of four stoves and the galley. One of the stoves was placed in the saloon, one in the engine-room, one between decks, and one in the second mess. With these heating appliances we had no difficulty in keeping up an equable temperature in all parts of the vessel even during the most severe cold (47° C). For fuel, part coals and part drift-wood were used, the latter brought from the neighboring shore. For heating purposes we consumed about 12 cwt. of coal weekly.

As I feared that the thick and rapidly forming ice might press with too great a force on the vessel, I endeavored at first to keep her free of the ice on the one side by opening, by means of the saw, a three-feet-broad channel. Soon, however, this work had to be abandoned, as the cold overpowered us. After opening up the stream the one day, on the next we found it covered with ice six to eight inches thick. Should there happen to be a snow-storm during the night, it was immediately filled up with snow, and then the ice became still thicker.

From the 1st of December until the 1st of April magnetic observations were made every hour; and in addition, on the 1st and 15th of every month, observations were made every five minutes. Meteorological observations were also taken every hour from the 1st of December till the 1st of April; for the remainder of our stay only every four hours. These observations were conducted by eleven persons, of which nine were men of science and officers, and two of the crew. The watch lasted for six hours, and the person on duty remained in the observatory all that time. The magnetic observatory consisted of a building twelve feet long and ten feet broad, erected on the land one hundred feet from the shore, and formed of sawn ice-blocks of an equal size. That we might, during snow-storms and darkness, have communication with the vessel without risk of losing our way, ice-pillars were raised at a distance of forty feet from each other, between which ropes were stretched.

During the whole time we were shut up the wind blew almost continually from N.N.W. to N.W. Winds from other quarters were exceptional. The winds between E.N.E., N., and S.W., were cold, while, on the contrary, the winds from S. and S.E. brought a milder temperature. In the first part of the winter, before the ice became too thick, the E. and S.E. winds broke it up and formed large holes or clefts north and east of the vessel. In a heavy northerly storm at the beginning of November, the newly-frozen ice one foot thick, pressing against the older and stronger, which lay aground on the outer sandbank directly astern of us, broke and piled up into *torosser* of some twenty feet high. On the same occasion the ice shot up on to the flat beach and accumulated in several places so as to form ice-walls of a similar height. On the 1st of January, about seven miles N.N.E. of the vessel, there was a channel running east and west, which was so broad that from its southern edge the northern was not discernible. During the latter part of the winter, when the cold became more intense, we could see no open water from our mast-head, but a continuous ice-field, whose even surface was only broken here and there by some old ice-blocks which had been frozen in by the new ice. Still, on several occasions we saw the so-called "water-sky," from which we inferred that open holes were to be found, although at a great distance. When in the month of May we opened up a channel on the one side of the vessel, the ice nearest us measured seven feet thick.

The accompanying table shows the thickness of the ice, which was measured on the 1st and 15th of every month, while the other indicates the medium, maximum, and minimum temperature for every month.

THICKNESS OF THE ICE.

	Ft.
November 1, 1878	0·96
December 1, "	1·90
December 15, "	2·70
January 1, 1879	3·10
February 1, "	3·65
February 15, "	4·04
March 1, "	4·16
March 15, "	4·24
April 1, "	4·30
April 15, "	4·68
May 1, "	5·20
May 15, "	5·45
June 1, "	5·20
June 15, "	5·10

TABLE OF TEMPERATURE (CENTIGRADE), TAKEN ON BOARD THE VEGA DURING 1878–79, AT L. N. 67° 7', L. W. 173° 24'.

	Medium.	Maximum.	Minimum.
October, 1878	— 5·21°	+ 0·8°	— 20·8°
November, "	— 16·59°	— 6·8°	— 27·2°
December, "	— 22·81°	+ 1·2°	— 37·1°
January, 1879	— 25·05°	— 4·1°	— 45·5°
February, "	— 25·08°	+ 0·2°	— 43·8°
March, "	— 21·65°	— 4·2°	— 39·8°
April, "	— 18·93°	— 4·6°	— 38·0°
May, "	— 6·79°	+ 1·8°	— 26·8°
June, "	— 0·60°	+ 6·8°	— 14·3°

In Sweden it is usually quite calm as soon as the temperature falls to 20° and under. At our winter station we often had strong wind with 38°, and storm with 30° and under. When the temperature fell under 40° it was generally calm or a light breeze, under 45° we had a complete calm. To go long stretches against a fresh breeze with 30° cold, or even colder, was anything but agreeable—nose, cheeks, and ears were easily liable to be frost-bitten. This can be obviated, however, without much difficulty, by binding a thin silk handkerchief over the nose, and letting the corners hang down over the mouth, by which inspiration is made less disagreeable than otherwise it would be. During the whole winter we had only a few very trifling injuries from the frost, notwithstanding that we were out in all possible weathers.

In the severest and coldest storms the watch in the magnetic observatory had to be changed every six hours. In the course of the winter we had some uncommonly high readings of the barometer—as, for example, on February 17th, at 6 P.M., 790 mm. at 67° Fahr., or reduced to decimals, = 788·1 mm.—which is four millimeters higher than the highest reading recorded in the literature we have on board.

From the beginning of the month of December we made hourly tidal observations. Ebb and flood could scarcely be distinguished. The greatest variation during the spring tide was only six to eight inches. The water-level, however, varied greatly according to the direction and strength of the wind. The extent of these changes was different for different winds; south-east and south winds usually brought high water, two to three feet over the common water-level. These observations were made by means of the following apparatus: A metal wheel of the circumference of a meter was fixed on the top of a boom. Over that wheel was laid a fine brass-wire line, the thickness of a common log line, the two ends of which were taken down through the rudder-hole, one upon each side of the helm. The one end was carried through a hole made in the ice beside the rudder, and fastened to two bars of iron which were sunk to the bottom; the other was fixed to a cannon ball at such a height that it was suspended in the center of the rudder-hole. The cannon ball served to keep the line constantly on the stretch. A board with foot and inch measurements was placed between the boom and the deck, and on the line an indicator which, according as the vessel rose or fell, pointed out on the scale the rising and falling of the water.

As we wintered in lat. N. 67° 7', we had not to endure the tedium of constant darkness, which is one of the trials of a winter spent in these regions in higher latitudes. On the darkest day of the year the sun, with the aid of refraction, showed half its disk above the horizon at mid-day. In the saloon, from 10 A.M. until 2 P.M., we had as much light as permitted us both to read and write. Outside, one could readily find their way about from 9 A.M. until 3 P.M.

Christmas was celebrated in the usual Swedish style—with Christmas tree, Christmas presents, fish, and sweet porridge. Christmas Eve was spent between decks, which for the occasion was decorated with suitable flags and signals. A wooden spar with willow branches (which had been brought from inland) tied to it did duty as a Christmas tree. It was hung with paper flags and two hundred presents, which latter were divided by lottery among the whole company.

During the winter we had several opportunities of sending home news of us, of which we naturally took advantage, although uncertain if these communications would ever arrive at their intended destination. So early as October we were visited by the chief Menka, mentioned before, and by him we sent letters and telegrams to Anadyrsk, to be forwarded from thence to Sweden. There is, however, no regular postal communication between Anadyrsk and the larger Siberian towns lying farther west. The letters would not arrive at Nijni Kolymsk until March, when a great annual market is held there. From thence they would be conveyed by visitors to the market homeward bound to Yakutsk, with which regular communication exists. In this way we could not expect our letters to arrive in Sweden before June or July. On several occasions we sent letters with natives on the homeward trip to Nijni Kolymsk, to be forwarded in a similar manner.

As far as the weather permitted, the crew always followed their various occupations in the open air, and it was only in extremely severe weather that they were allowed to work under deck. During their leisure hours they had access to an exceedingly well supplied library; and for their profit and amusement suitable lectures were given every Saturday evening during the darkest season—which, thanks to our scientific companions, were as interesting as they were instructive. In addition to the common rations, in regard to which the subjoined table* of dietary gives information, the crew received daily during the spring months two cubic inches of cranberry preserve twice a week, five cubic inches mulberry preserve four times a week, pickles, besides fresh fish or reindeer flesh as often as they could be obtained by barter from the natives—usually once a week.

As something remarkable and, so far as known to me, unexampled in the instances on record of winters passed in these regions, not a symptom of scurvy appeared on board the Vega during our stay. In my opinion our exemption may be attributed to the following circumstances:

1st. That we were supplied with sound, good, and, for our habits, suitable food.

2d. That we never had unbroken darkness, which exercises a depressing influence on the spirits.

3d. That we did not suffer from damp of any moment on board, consequent on the Vega's thick sides, and an equable heat being preserved; and,

4th. That we all led an industrious life.

Spring seemed to delay her coming. On the 31st of May the sun was circumpolar; but, notwithstanding, its rays were yet without sufficient strength to dissolve the masses of snow which were accumulated on the land. Not until the middle of June did the snow begin noticeably to diminish day by day, and in the beginning of July the ground was for the most part bare. Immediately after the melting of the snow the land became green, and the flowers sprang up. It is wonderful how rapidly winter and summer succeed one another in the Arctic regions. No sooner has a tuft become bare than it is verdant and flower-clad. This sudden change is absolutely necessary in order that, during the short summer of barely two months, everything may quickly mature and furnish seed for another growth.

While the snow was melting, a great number of birds had gathered and hovered about the streams and lagoons which lay at a longer or shorter distance from shore. Our hunters had occupation from morning till night, and our table was always supplied with feathered game of every description, the most appreciated being geese and sandpipers. The melting of both floating and ground ice went on rapidly during this time. In the vicinity of the ship the thickness of the ice diminished one or two inches daily, depending on whether the wind was north or south. The former brought a colder, and the latter, which often blew a gale, a warmer atmosphere. Open holes and long narrow runnels began to appear to the north and northeast of the vessel. These opened and closed according to the quarter from whence the wind blew, whether south or north, which indicated that the ice outside was in motion. In the beginning and middle of July a great quantity of water stood on the ice to the inward of the vessel, and communication with the land became daily more and more difficult.

On the 18th July, during a stiff breeze from the south, I noticed that the line to our tidometer showed astern; and immediately after, I saw the ice to the landward of us separating from the outerground ice belt. The engine-fires were lit, and at half past four P.M. the vessel was set in motion. Half an hour later we were out in a channel which continually increased in breadth the farther we proceeded, and before evening we were in a comparatively navigable sea. After a detention of nine months and twenty days, we had at last got away as quietly and with as little risk or trouble as if we had gone out to sea from a common harbor.

On Sunday, the 20th of July, at 11 A.M., we passed East Cape, and had then quite completed the North-east Passage.

* BILL OF FARE FOR THE VEGA.

	BREAKFAST.	DINNER.	EVENING MEAL.
No. 1.	Butter 0·06 lb. Coffee 0·10 " Sugar 0·08 "	Salt pork 0·75 lb. Pickled or preserved cabbage 0·75 " Preserved potatoes 0·12 " Extract of beef 0·02 " Preserved vegetables 0·05 " Rice 0·50 " Raisins 0·05 " Rum or brandy 1 gill.	Butter 0·06 lb. Tea 0·02 " Sugar 0·08 " Cheese 0·12 " Barley
No. 2.	Same as No. 1.	Preserved meat 1 ration. Preserved potatoes 0·12 lb. Preserved vegetables 0·05 " Preserved onions 1 ration. Extract of beef 0·02 lb. Brandy or rum 1 gill.	Same as No. 1, but without cheese.
No. 3.	Same as No. 1.	Salt pork 1 lb. Peas Extract of beef Barley Brandy or rum	Same as No. 2.
No. 4.	Butter 0·06 lb. Chocolate 0·10 "	Salt beef 1 lb. Macaroni 0·15 " or Brown beans 0·10 " Preserved green peas 1 ration. Fruit soup 1 " Brandy or rum	Same as No. 2.
No. 5.	Same as No. 4.	Preserved collops, or preserved beef-a-la-mode Preserved potatoes 0·12 lb. Preserved onions 1 ration. Fruit soup Brandy or rum	Same as No. 2.

Besides every man was allowed—

Daily—1¼ lb. dry bread, or 1¼ lb. flour (two-thirds wheat and one-third rye), 0·03 lb. tobacco, and 1 cubic inch lime-juice.

Per Week.—1 lb. flour, 0·30 lb. butter, 0·21 salt, 0·03 lb. pepper, 0·07 lb. mustard, and 2 cubic inches vinegar.

No. 1.—When fresh meat and vegetables could be got, they were substituted for those in No. 2, in accordance with the regulations in the Royal Navy.

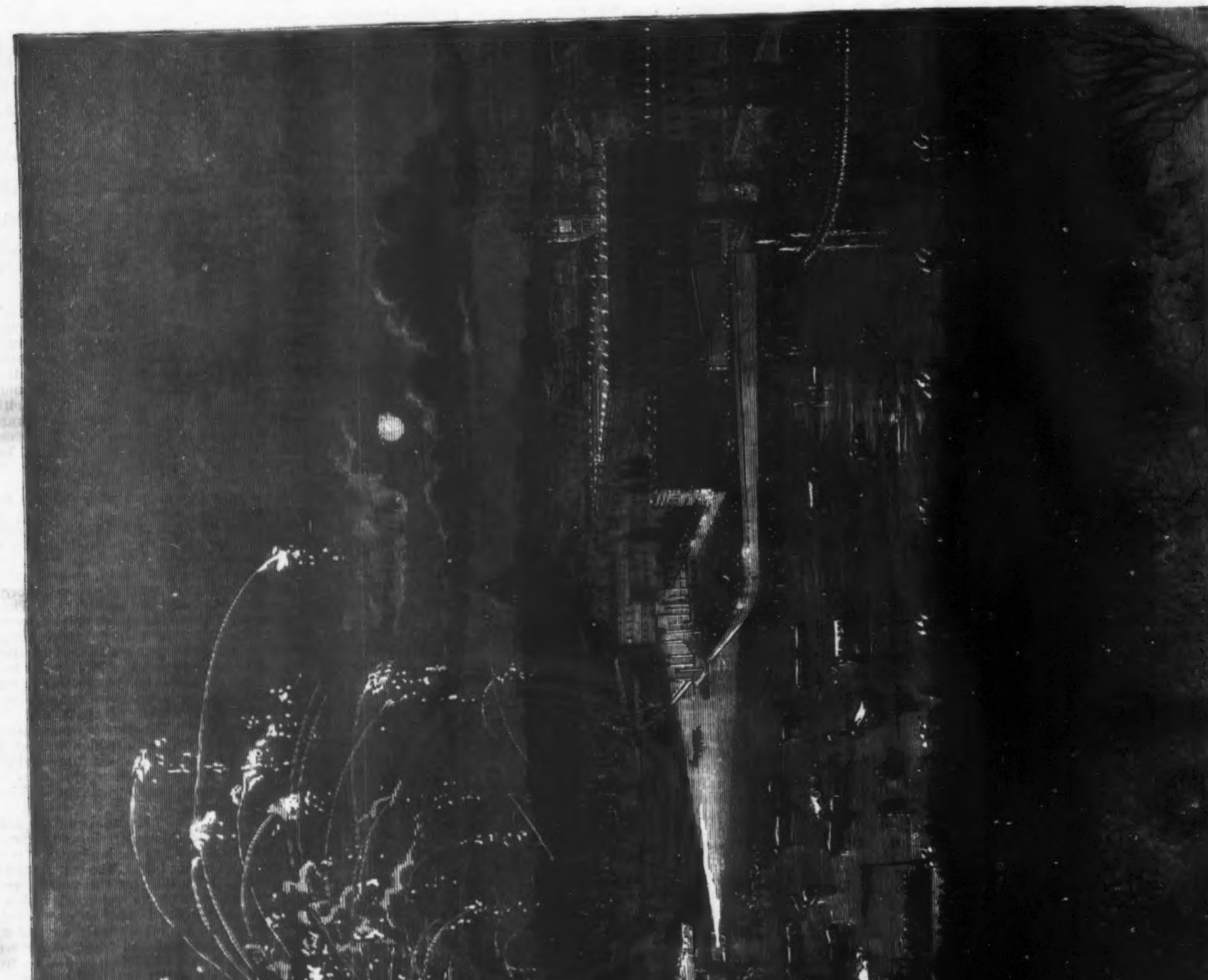
No. 2.—The different numbers were distributed in the following manner: No. 1, Sundays; No. 2, Mondays, Wednesdays, and Fridays; No. 3, Thursdays; No. 4, Tuesdays; No. 5, Saturdays.

No. 3.—Besides those already mentioned, we had several extra articles of provision—viz., pickles, preserved milk, mulberry-jam, etc.

In celebration of this event the national flag was hoisted and a salute given. The same evening we anchored at the mouth of St. Lawrence Bay.

The North-east Passage has unquestionably been accomplished for the first time by the Swedish steamship Vega. I attribute the circumstance that this has occupied a year, when it ought to have taken only two months, had there been no special difficulties, to the unusually unfavorable condition of the ice during September, 1878.

To answer the question, If the North-east Passage can annually be made in one season? I am not able, because the ice conditions are so different in different years. The part of the sea nearest the coast is certainly free from ice, during the summer and autumn months, opposite to and east from the efflux of a river; but against this must be placed the difficulties to be met with at and around Cape Tchelyuskin and Taimyr Island. That a passage is to be found there also once or several times in the summer is equally certain, but that may occur so late that before one can reach Behring Strait the winter has again set in. At the same time I will not by any means say that there may not be found there during the whole summer and autumn a channel free from ice; but as there is no river affluent in the vicinity of Cape Tchelyuskin and Taimyr Island, which, with sufficient strength, can force the ice northward, as is the case with the great rivers, Obi, Yenisei, Lena, and Kolyma, it may be inferred that the ice there is principally influenced by the winds—namely, that the north wind forces the ice towards land, the south having a contrary effect, and that, consequently, the doubling of these points cannot be calculated upon with certainty at any time, even during the navigable season. The North-east Passage cannot therefore in its entirety be made available for the purposes of commerce; but still an annual traffic might easily be carried on from the westward to the Obi and Yenisei, and from the eastward to the Lena. Unquestionably the way now lies open to Siberia's three greatest rivers; and that land, so rich in minerals, timber, and grain, whose export and import trade has hitherto been conducted by means of caravans, ought now



RECEPTION OF PROFESSOR NORDENSKJOLD, THE SWEDISH ARCTIC EXPLORER, AT STOCKHOLM.

to obtain a practicable route as a connecting link between the New and Old Worlds. In regard to the communication with Yenisei, since Professor Nordenskjöld, for the first time reached that river in 1875, it has been annually visited by European vessels, conveying European commodities to Siberia, and returning from thence loaded with Siberian products. The traffic to the Lena will probably be taken up by American traders; and the safety of the voyage there and back should be insured when a chart of the Siberian coast has been obtained, also by the employment of strong and swift steamers.

At St. Lawrence Bay we remained only till mid-day on the 21st of July, when we weighed anchor and steered over to the American side, where we anchored at Port Clarence. We remained there till the 26th, when we again crossed over to the Asiatic side, and anchored in Konyam Bay. From thence we went, on the 28th, to St. Lawrence Island, remaining there from the 31st of July till the 2d of August. We then steered for Behring Island, where we anchored at its south-west point on August 14. We found here a small village with a church, and twenty-five wooden houses built and owned by an American firm, Hutchinson, Kohl, Philippens & Co., who here, and on the neighboring islands, carry on seal fishing. The inhabitants of the island, consisting of a few Russian government officials, some *employes* of the company and natives of the Aleutian Islands, make in all about three hundred who reside in the village. There we received our first news from Europe through American newspapers, whereof the last were printed in San Francisco, in April, 1879, and brought from thence by one of the company's steamers. On the 19th of August we left Behring Island and set our course for Yokohama, where we arrived on the evening of the 2d of September.—*Blackwood's Magazine.*

THE SWEDISH ARCTIC EXPEDITION.

WE gave an account last week of the arrival of the Swedish Arctic exploring vessel, the small steamer Vega, at the home port of Stockholm, and the reception of Professor Nordenskjöld and his companions by the King of Sweden and Norway. Our illustration of the festal illuminations there, from a sketch by a Swedish correspondent, will not, therefore demand a further explanation. It was late on the Saturday evening, the 24th April, when the Arctic voyagers and circumnavigators of Northern Asia, who had been away since July 4, 1878, landed at Stockholm. They were first welcomed by the municipal authorities, and were then, by the King's command, escorted to the Royal Palace, where his Majesty Oscar II. greeted them with the utmost cordiality. The next day being Sunday, there was a thanksgiving service for their safe return, in the Royal Chapel, after which the King went to visit the ship, and presented to each of her officers and crew a medal commemorative of her adventurous voyage. In the evening there was a banquet at the palace or castle, where his Majesty proposed the health of Professor Nordenskjöld, Captain Palander, and the other explorers, in a very animated speech. The beautiful scene of the harbor quays, and surrounding buildings of the city, with the many vessels, boats, and steam launches, lighted up by the illuminations and fireworks, is well shown in the view we have engraved. Our engraving opposite is from the *Illustrated London News.*

DISTRIBUTION OF LAKES IN THE UNITED STATES.

By PROF. JOHN LE CONTE.

THERE are numerous lacustrine basins to be found in the States bordering the Pacific Ocean. As in other regions of the globe, their distribution is determined by the configuration of land, or, more specifically, by the forms of the great hydrographic basins in the interior of the continent; hence some general idea of the topography of the western portions of the United States is an essential preliminary.

TOPOGRAPHY.

One of the grand topographical features of the two American continents is the system of mountains bordering on the Pacific Coast, extending from Cape Horn to the North Polar Sea. This vast system of mountain chains has been collectively designated by some geographers as the Cordilleras. Different portions of it have received special designations, as the Andes, in South America; the Sierra Madre, in Mexico; and the Rocky Mountains, the Sierra Nevada, and the Cascade Range, in the United States. This great mountain system, entering the United States from Mexico, rapidly widens and subdivides into a labyrinth of mountain ranges, the whole mass having a maximum width near the parallel of 39° or 40° of about 1,000 miles. According to Prof. J. D. Whitney, the whole area embraced within this mountainous belt is but little, if any, short of 1,000,000 of square miles. The enormous mass included within the extreme boundaries is of a somewhat lozenge-shape, the length of each side being about 600 or 800 miles; "is formed by the Sierra Nevada and the Cascade Range on the two westerly faces, and by the Rocky Mountains, with the Big Horn, Wind River, and Bitter Root ranges, on the two easterly faces." Between these two gigantic mountain systems lies the

GREAT INTERIOR PLATEAU,

which constitutes the great physical feature of our territory. The plateau thus inclosed has in its central section, from east to west, in the pathway along which civilization has advanced, an elevation of 3,000 to 7,000 feet, falling off to the north and to the south, and in the latter direction sinking more than 200 feet below the sea level. The drainage of this vast area is accomplished by three great rivers and their numerous tributaries, viz.: 1. The Columbia River in the North, discharging into the Pacific Ocean. 2. The Rio Colorado of the West, discharging into the Gulf of California. 3. And the Rio Grande del Norte, discharging into the Gulf of Mexico. That portion of this great plateau which has been designated the great interior basin is without outlet to the sea. The great plateau is traversed by various ranges of mountains, of which the Wahsatch, extending north and south through nearly 400 miles, is the most notable. Between the Wahsatch and the Rocky Mountains runs the Uintah Range, the only high and well-defined chain in the Cordilleras having an east and west trend. It is likewise traversed by several subordinate ranges of considerable magnitude, and is diversified by innumerable spurs and ridges, transverse narrow valleys, and occasionally broad plains, the valleys being sometimes green, attractive, and refreshing, while the plains are always arid, repulsive, and desolate to the last degree.

It is evident that this portion of our territory lying between the lofty snow-clad Rocky Mountains on its eastern margin and the Sierra Nevada Mountains on its western boundary, can receive but a scanty supply of moisture from the vapor-bearing winds coming from either the Atlantic Ocean and the Gulf of Mexico on the one hand or from the Pacific Ocean on the other. Many of the streams are largely supplied with water from the melting of the snows which crown the summits of the two great mountain boundaries. Many portions of these arid plains only need water to render them fruitful; in such cases, when irrigation is practicable, the seeming desert may be made to blossom.

GREAT BASIN.

The central portions of what we have designated as the great plateau is divided into two distinct regions by the Wahsatch range of mountains trending north and south near the eastern borders of the Great Salt Lake for about 400 miles, viz.: 1. The great plateau proper lying, at an elevation of about 7,000 feet above the sea level, between the Rocky Mountains on the east and the Wahsatch Mountains on the west. 2. The great basin lying, at an elevation of about 4,000 to 5,000 feet, between the Wahsatch range on the east and the Sierra Nevada on the west. The region occupied by the mountains bordering the great basin has no drainage into the sea; the streams that head in the mountains find their way into saline lakes, disappear in sinks, or are lost in the sands of the deserts, where their waters are evaporated.

The great basin region is subdivided by the Humboldt Mountains into two sub-basins, viz.: *a*. The Salt Lake Basin, in which lie Salt Lake, Utah Lake, and Sevier Lake. During glacial times there was a large expanse of fresh water in this basin; and, according to G. K. Gilbert, at some former period, the waters of this basin rose so high that they overflowed to the ocean through Red Rock Pass into the Snake and Columbia Rivers; at this epoch its water level was about 960 feet above the present level of the Great Salt Lake. *b*. The second sub-basin is the Humboldt Basin, which lies between the Humboldt range and the Sierra Nevada. A number of smaller lakes and sinks, such as Pyramid Lake, Humboldt Sink, Carson Lake, Walker's Lake, and others, which dot the surface of the State of Nevada; and likewise Mono and Owen's Lakes, in California, are included in the same general depression. The estimated area of these two interior basins, without outlet to the sea, is about 210,274 square miles.

GREAT CALIFORNIA VALLEY.

Every one is familiar with the fact of the existence in California of two great masses of mountains, one designated the Sierra Nevada, lying in the eastern portion of the State, and the other the Coast ranges, bordering on the sea near the western boundary. Between the parallels of 35° to 40° there is no difficulty in separating the Coast ranges from the Sierra Nevada.

The great California valley, composed of the Sacramento and the San Joaquin, varying in width from 40 to 60 miles, forms a striking feature in the topography, being walled in by the Sierra Nevada on the one hand and the Coast ranges on the other. The broad valley thus defined forms a complete separation of the two systems of mountain chains. But, if we go south or north of latitudes 35° and 40° respectively, the condition of things changes. In the neighborhood of the Tejon Pass, about latitude 35°, the ridges of the Sierra Nevada and Coast ranges come together, inosculate and become continuous, and topography alone, independently of geological considerations, affords no clew to where one ceases and the other begins. The same is the case with regard to these two mountain ranges north of the head of the Sacramento valley. North of Shasta City (latitude 40° 35′) the ranges close in on all sides, and in the labyrinth of chains there is no possibility of preserving the distinction between the Sierra Nevada and the Coast ranges. Within these limits and along an axial line, having a direction of north, 31° west, extending for a distance of about 400 miles, the topographical features of California assume a grand simplicity.

Nearly parallel to each other we have: 1. The eastern slope of the Sierra Nevada extending into the State of Nevada. 2. The Sierra Nevada range of mountains. 3. The great valley of California. 4. The Coast ranges.

Passing north of California into Oregon, we come, in latitude 43°, to two beautiful and fertile valleys of the Umpqua and Willamette, which here form almost as striking a separation between the Cascade Mountains on the east and the Coast range on the west as does the great California valley.

ARID REGIONS.

In the United States the regions of the great plains—the vast, treeless country that stretches away from the eastern base of the Rocky Mountains and the great plateaus and basins lying west of the same range of mountains—constitute the arid areas, where agricultural operations are impracticable without more or less irrigation. It has been estimated that this arid region is more than one-third of the entire area embraced in the United States. From actual surveys and careful estimates, it would seem that it will not be possible to redeem more than three per cent. by irrigation, when every brook, creek, and river is utilized. Less than four per cent. of the region can be said to be forest-clad. These forests are restricted to the sides of the high mountains, and extend over the more elevated foothills. This does not include large areas covered with a scanty growth of dwarf cedars and pines, useful for fuel, but of no value in mechanical industries. Over the remaining districts a large portion is covered with grasses and other plants, which may to some extent be utilized for pasturage. Small valleys lying along mountain streams will doubtless receive the most careful and elaborate culture, affording fertile grain fields, vineyards, orchards, and gardens. The mountains, hills, and plains will furnish nutritious but scant pasturage for herds and flocks, but, after all, the agricultural resources of this vast area must be very limited. Gold, silver, copper, iron, coal, salt, and many other minerals are found in abundance; so that the region will be chiefly valuable for its mineral wealth.

CAUSE OF ARIDITY.

The mechanical causes of all terrestrial currents of air or winds must be sought for in the disturbance of atmospheric equilibrium produced by the unequal distribution of solar heat on the surface of the globe. Solar heat must, therefore, be looked upon as the "*primum mobile*," which originates and keeps in continual action the agencies which perpetuate the atmospheric circulation. In other words, the action of solar heat, combined with the very important modification produced by the rotation of the earth upon its axis, affords a full and satisfactory explanation, at least in a general and comprehensive view of the great systems of winds. The operation of this good physical cause necessitates the general prevalence of west winds near the surface of the earth in the temperate zones. The great water surfaces are the chief sources whence the largest supply of moisture in the form of aqueous vapor is derived. The winds are the chief mechanical agents by which those vapors wafted to distant points where they are condensed into rain or snow, dropping richness and fertility on our fields, and covering our hills and mountain slopes with vestments of verdure. The land is, directly or indirectly, the agent which brings about the condensation of aqueous vapor. It accomplishes this result, either (as in the case of winds carrying vapors up mountain slopes) by forcing the vapors into higher and colder regions, or by creating upward currents of air by the action of solar heat, and thus conveying the vapors aloft into the colder regions of the atmosphere. Thus, in a general sense the oceans, seas, and lakes, constitute a vast vapor furnishing apparatus, while the continents and islands constitute a huge condensing apparatus; between them a gigantic process of distillation is carried on, which waters the earth and clothes the land with vegetation. Moreover, it must not be forgotten that the great thermal influence emanating from the sun alone has the power of putting in motion this immense apparatus. For the western portions of our territory, the Pacific Ocean constitutes the great vapor furnishing surface; the prevailing west winds sweep the vapors upon the lands lying to the east of the ocean, and the mountain ranges furnish the condensing apparatus. It is evident, therefore, that all aqueous phenomena of the atmosphere, embracing fog, rain, and snow, may be rationally accounted for by attending to the three following considerations: (1) The position of bodies of water furnishing aqueous vapor of greater or less tension; the degree of tension having relation to the temperature of the water. (2) The direction of the prevailing winds sweeping the vapor to regions of condensation or otherwise. (3) The configuration of the adjacent and remote lands, in promoting or opposing the operation of causes producing condensation of the vapors.

APPLICATIONS.

These general physical principles are readily applied to the explanation of the aridity of the extensive areas lying east of the Sierra Nevada and Cascade mountains. Through the whole length of California the Sierra Nevada are lofty and continuous, presenting an almost unbroken chain, with an average elevation of about 10,000 feet. This "great sea wall" almost completely shuts off the moisture borne by the vapor-bearing west winds coming from the Pacific Ocean. The small amount of moisture that surmounts the lofty snow-clad crests of these mountains is barely sufficient to produce a scanty precipitation of rain and snow from December to May each year, during the rainy season of the coast ranges. Hence we find east of this huge wall through the central portion of the State of Nevada, from the mud lakes of the north through the Humboldt desert and the great Salt Valley, and on the south to Death Valley, in California, a region of extreme aridity and barrenness. Most of this vast area is dreary and desolate beyond conception, being nearly destitute of water and vegetation, fearfully hot in summer, and occasionally swept by terrible sand storms. North of latitude 41° the Cascade and other ranges constituting the continuation of the Sierra Nevada mountains, have a mean elevation of only about 6,000 to 7,000 feet; so that a somewhat larger supply of moisture from the Pacific Ocean reaches the plateaus and basins lying between them and the Rocky Mountains. It is principally for this reason that eastern portions of Washington Territory, and Oregon, and the whole of Idaho, although situated in northern extensions of the arid regions, receive a somewhat larger supply of rain than corresponding districts in Nevada and California.

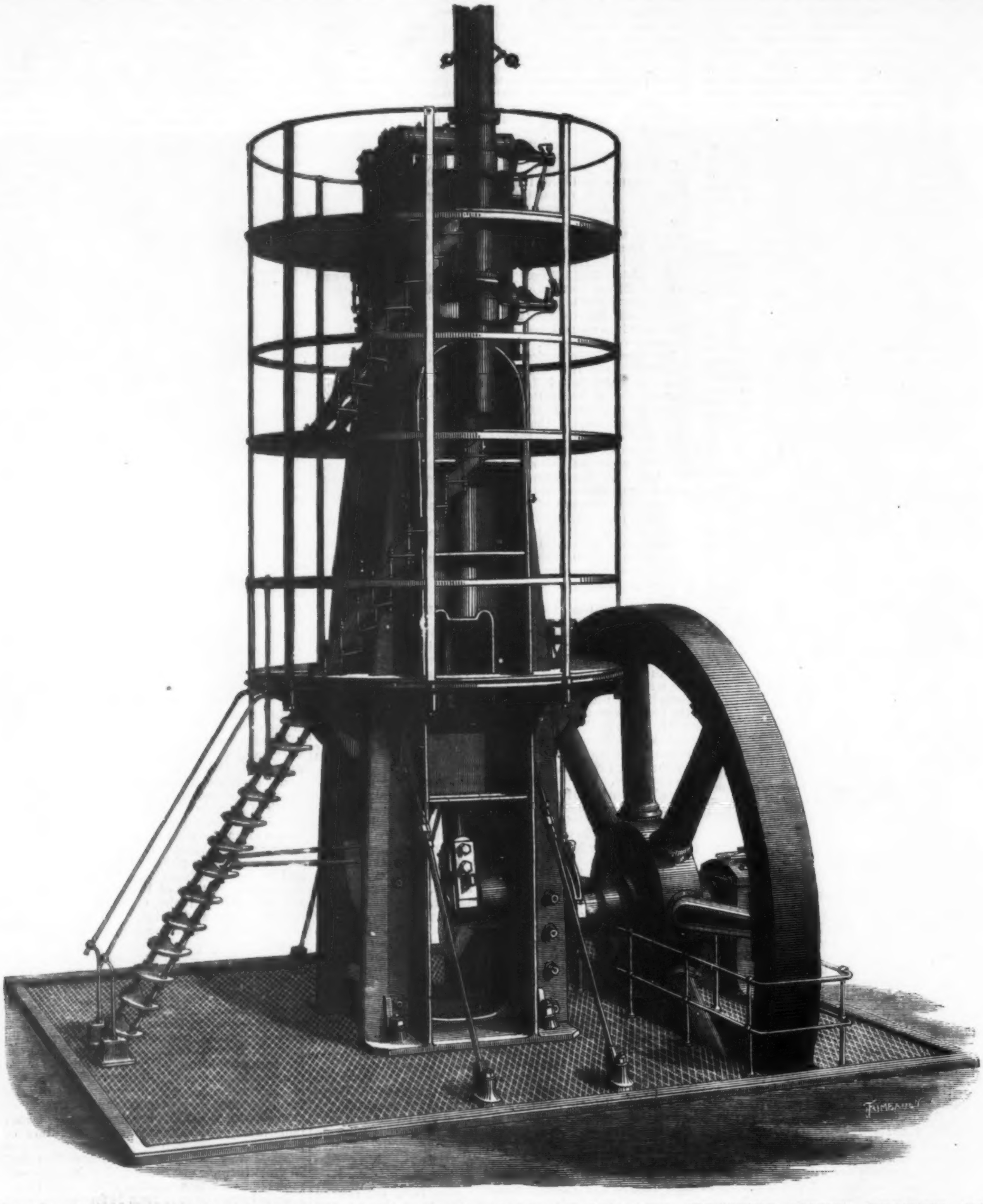
It has already been remarked that there are unquestionable indications that in a former epoch a large portion of the great basin was covered with water. During the Champlain epoch these arid plains were covered with immense sheets of water, of which the existing saline lakes are the isolated residues. Hence it follows that the extreme dryness of climate now existing in these regions did not always prevail. Since the above-mentioned geological epoch there has been an increasing dryness of climate over the whole of the great basin. Is it still progressing, or has it reached its maximum of aridity? Is the great cycle of humidity returning upon these desert plains, and will they once more be clothed with vegetation at some future period? These are important questions in relation to the future of the Pacific States.

There are certainly many evidences that during the past 25 years there has been a decided increase of rainfall and snowfall over a large portion of the great basin. Great Salt Lake is known to have risen 14 feet within the last 25 years, thereby submerging large tracts of land on its flat margins; and chemical analyses show that its waters are progressively freshing. According to the observations of Clarence King, during only four years (1867–71) Pyramid Lake has risen nine feet, and Winnemucca Lake 22 feet within the same short period. In like manner Mono Lake has risen 10 or 12 feet during the last 15 years. The same is said to be true of Walker's Lake and of Owen's Lake. Additional evidence of the increasing snowfall in the Sierra Nevada is afforded by the fact that the glacial masses, which cover the flanks of its lofty mountain peaks, seem to be advancing on the foothills. It would seem, therefore, that the rise of the lakes occupying the great basin is undoubtedly the result of a climatic cycle.

The momentous question for the future prosperity of the Pacific States is whether the cycle is to be a long or short one; whether it is to be a geological cycle of augmenting rainfall and snowfall constituting a secular change of climate; or whether it is to be only a climatic fluctuation of such short duration as to exercise no appreciable influence or development of the vegetable and animal kingdoms.

This vital question cannot, from the want of sufficient data, be answered at the present time. Our successors will, without doubt, be able after the lapse of sufficient time to accumulate accurately-observed facts numerous enough to warrant the deduction of trustworthy conclusions.—*Mining and Scientific Press.*

THE *Family Herald* not long ago produced the following extraordinary statement: "It is not generally known that indigo is *excessively poisonous.*" We certainly never met with a blue-dyer who had felt any inconvenience from daily contact with this excessively poisonous ware. It is also surprising, if the opinion of our worthy contemporary is correct, that the authorities, both in France and Germany, acting upon the best scientific advice, mention indigo and its solutions among the colors which may be lawfully used for sweetmeats.



VERTICAL ENGINE (CORLISS SYSTEM) FOR RAIL MILL AT MESSRS. KRUPP'S STEEL WORKS, ESSEN.

ROLLING MILL ENGINE.

IT is somewhat singular, considering the great irregularity in the amount of power demanded from rolling mill engines, that such engines should in comparatively few instances have been fitted with automatic expansion gear. In the United States, Mr. Corliss many years ago took up this matter, and the engines fitted with his well-known gear and erected by him at the works of the Nashua Iron and Steel Company, the Joliet Iron and Steel Company, etc., have done good service. In this country Mr. Webb some time ago put down a fine Corliss engine to drive the three-high rail mill at Crewe, while Mr. Jeremiah Head has with good results applied automatic expansion gear of another type designed by himself to engines at the works of his firm, Messrs. Fox, Head & Co., but the system of fitting rolling mill engines with automatic expansion gear has not yet made either here or on the continent the progress which its merits deserve.

In applying his system to rolling mill engines Mr. Corliss departed in many respects from his ordinary practice for stationary engines. Thus, in the first place, he adopted the vertical instead of the horizontal type, in the view of its being better adapted for the high piston speed at which his rolling mill engines run, and also from its occupying less space in the mill floor. He also adopted very liberal proportions for the various bearing surfaces, and made special provisions for shielding them from the dust always present in a rolling mill.

On the continent Mr. Corliss's plans have been taken up by M. P. Van den Kerchove, of Ghent, who has been for many years a most successful maker of Corliss engines, and we this week give two engravings containing views of an engine of this type constructed for Messrs. Krupp's works, at Essen. We may mention that before ordering this engine Mr. Krupp sent some members of his staff to the United States to examine into the working of the Corliss rolling mill engines there, and it was in consequence of their report that the adoption of the type was decided upon.

The engine illustrated has a 36-inch cylinder with 5 feet stroke, and it is run at 80 revolutions per minute, the piston speed being thus 800 feet per minute. The engine drives a rail mill direct, and is capable of indicating over 800 horse power. The design of the engine frame is somewhat peculiar, and will be better understood from an examination of our engravings than from any verbal description. As will be seen, the area of base of the frame proper is very moderate, but, to give the necessary lateral stability against the thrust of the crosshead on the guide bars, wrought-iron diagonal stays are provided and arranged, as shown, these stays being provided with right and left hand screws for setting them up tight. Three galleries at different heights, and provided with staircases, give the necessary access to the various parts of the engine.

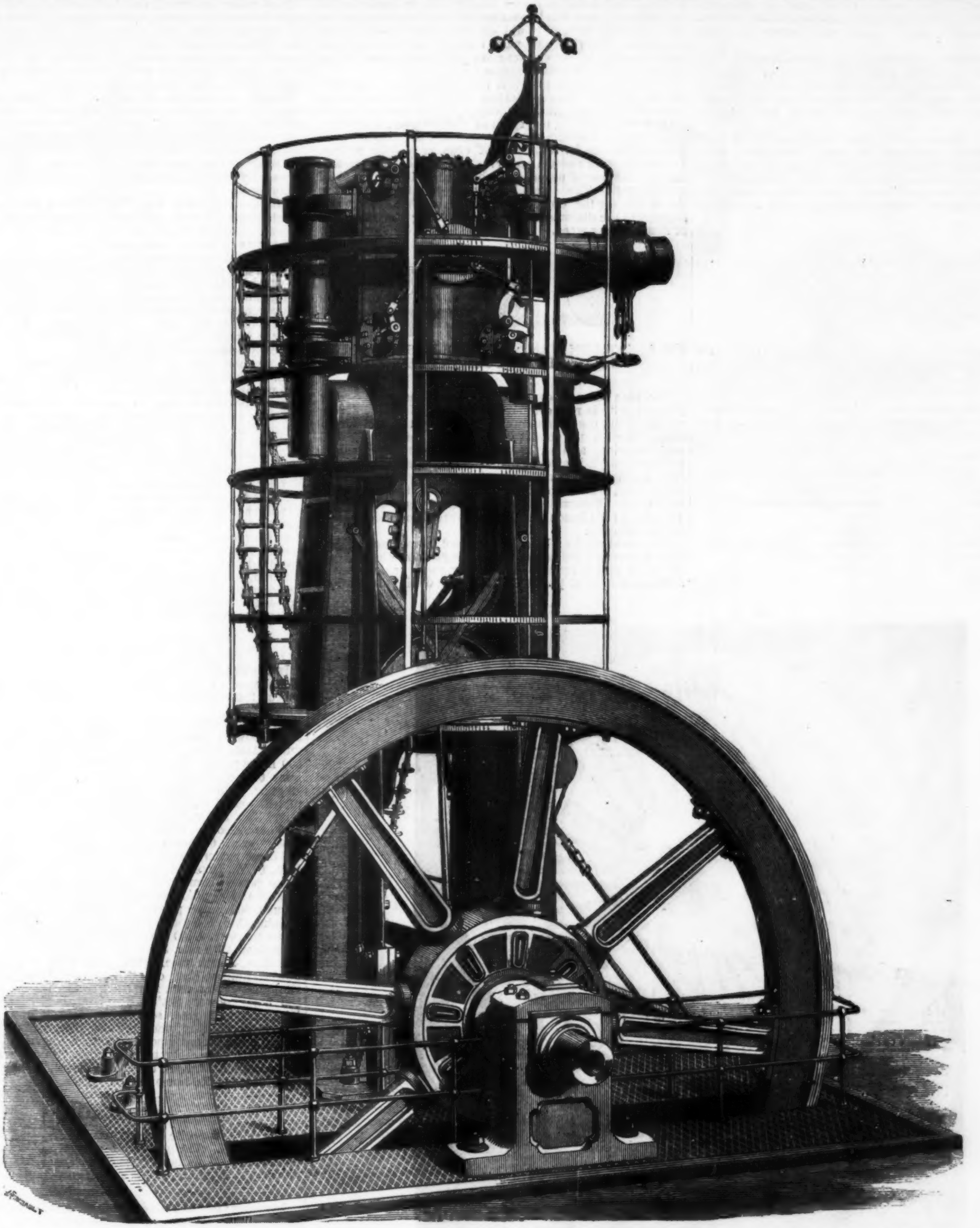
The engine is, of course, wholly controlled by the governor, and those familiar with the working of the Corliss gear will well understand that the control is thoroughly efficient even under extreme variations of load. The engine at Messrs. Krupp's has now been running more than a year, and it has, we understand, given every satisfaction.—*Engineering.*

THE locomotive built for speed, noticed in this paper a few weeks since, made a trial trip from Philadelphia to Jersey City and back, May 14. With a train of four cars the distance from Philadelphia to Bound Brook, 59¼ miles, was made in 63 minutes, and from Bound Brook to Jersey City, $30\frac{3}{16}$ miles, in 34 minutes, or the total run of 89½ miles in 97 minutes. Returning to Philadelphia, with five cars, the train left Jersey City at 2 11 15 P.M., arriving at Bound Brook at 2:45 P.M., and Philadelphia at 3.42 P.M., making the distance of 89½ miles in 1.30:35.

BENEFITS OF GOOD TOOLS.

THERE is an old saying to the effect that "it takes a good workman to make a good job with poor tools." So it does; and there have been many triumphs, recorded and unrecorded, of brain and skill over seemingly insurmountable obstacles. It is a satisfaction to compass a result with apparently inadequate means, and the mechanic who does it is justly proud of his success. But working with poor tools is never certain to produce good results, however great the skill and inventive the brain. Misses are made as well as hits, and even the most self-assured workman feels safer with good and applicable tools. No workman can afford to risk his reputation and success with poor tools; there is so much risk of a failure and such anxiety for the result, that even if success is attained it has been at the expense of time, thought, muscle, and trouble, that robs it of half its gratification.

The time has gone by when the workman was expected to "make something out of nothing;" when one implement or appliance was made to do duty for another, and "makeshifts," their origination, use, and application to the job in hand were part of the kit of the workman. The constant and growing improvement in tools and labor-saving machinery has not only increased the profits of the manufacturer, but lightened the labor of the workman. The machinist who learned his trade thirty years ago would now be ashamed to resort to the wretched substitutes of tools with which he was then compelled to do his work. The carpenter knows the advantages of the mortising machine, the moulding machine, the band-saw, and other improvements. The blacksmith sees the advantages of the drop-hammer, the shears, the steam-hammer, and the portable forge; and even the farmer, who keeps up with the times, appreciates the mowing machine and the many improved hand-tools which facilitate his operations and reduce his



VERTICAL ENGINE (CORLISS SYSTEM) FOR RAIL MILL AT MESSRS. KRUPP'S STEEL WORKS, ESSEN.

labor. There may have been brain energy and labor wasted in the production of improved tools and appliances; for there are some which have never met the expectations of their contrivers or filled the wants of the users. But in truth, there has been no portion or department of mechanical endeavor that has accomplished better results or reached higher success. The number of special tools now used is wonderfully great as compared with thirty years ago. There is no manufacture of consequence that has not its special appliances, machinery, and tools, and in tools for general work the improvement has been fully as marked. Even in hand-tools the improvement is obvious to the slightest observation. In every department of industry these improvements have made their mark. They save time and labor, and produce more satisfactory results. It is a wise economy to reject imperfect tools, and, as the patent-medicine men advertise, "use the best." Whenever an improved implement is put into the market—one that will do the work better or quicker—it is economy to buy it, even if the old one is intact and serviceable. —*Boston Journal of Commerce.*

STEEL MAKING IN CHINA.

IN the manufacture and use of steel the Chinese appear to have attained a very early and remarkable proficiency. Chinese records do not enlighten us as to the precise period at which the art of reducing metals from their ores became known in that country, but it is evident that it must have been some centuries before the Christian era. Mention is made of steel in the most ancient of the Chinese writings, and Leih-tze, an author who flourished about 400 B.C., describes the process by which it was made. In the Yu Kung section of the Shoo King, Book I., it is stated that among the articles forming the tribute of Yu, were nautical gem stones, iron, silver, steel, stones for arrow heads, etc. Legge points out that, in the time of the Hau dynasty, ironmasters were appointed in several districts of the old Leangchou to superintend the iron works. With the exception of this passage, however, it is considered probable that there is no distinct allusion to iron in Chinese writings older than 1000 B.C.

In describing the manufacture of steel in China, the Pi-tan or Pencil-Talk, states that wrought iron is bent or twisted up, and unwrought iron is thrown into it. It is then covered up with mud and subjected to the action of fire, and afterwards to the hammer. At a subsequent period the Chinese records describe the different kinds of steel produced. That obtained by the first process they call ball steel, *Twan Kang* (from its rounded form), or sprinkled steel, *Kwan Kang* (from the pouring of water). Another kind is spoken of as "false steel," "wei tee," and it is quaintly added that "iron has steel within it, as meal contains vermicelli. "In the "Peut Saow" (a work of the Ming dynasty), again, three kinds of steel are described, thus: "1. That which is produced by the adding of unwrought to wrought iron while the mass is subject to the action of fire. 2. Pure iron many times subjected to fire produces steel. 3. Native steel, produced in the south-west, at Hai Shau, and which is like in appearance to the stone called *Tsze-shit-ying*—purple stone efflorescence."

Steel continues to be manufactured in China to the present day. Mr. James Henderson, a commissioner of Li-hung-chang, the Governor-General of Chilili, and minister of the young king of China, states that "the steel which comes to Tien-tzin from the Upper Yangtzee is highly prized, and bears much higher prices than the Swedish steel imported into China."

A NEW ADULTERATION OF JELLIES.

IT is always interesting to see how much ability is exhibited in commerce in the ingenious work of adulterating food products; but there is reason to rejoice at the sagacity which chemists display in laying bare the best disguised of these ruses. A very nice piece of work of Prof. Menier, of the School of Medicine, at Nantes, in a curious case of falsification of preserves, will furnish a good example of this.

"But," the reader will doubtless say, "what can be put into currant jelly to adulterate it? Probably, a little gelatine to give it consistency, and a little cochineal to color it. But is not that done in our own houses, and is that reprehensible?"

Certainly; it is always wrong to change the quality of an aliment, even to a slight degree. But, even supposing these additions be admitted as harmless, such preserves would be far from representing so enigmatical a product as that examined by Prof. Menier, and in which he found neither currants, nor sugar, nor even gelatine! Sugar is dear, so are currants, and gelatine is at a price beyond reach. So thought the inventor of this beautiful mixture.

"Well, let us do without these things, and let us also do away with the pot, which amounts to two cents, and let us substitute for it a tin box that costs less than one cent. As for the contents, let us substitute——"

But the manufacturer, who is a celebrated Parisian manufacturer of preserves, has taken good care not to divulge this either to the public or the grocer. To the latter, however, he addressed this language:

"Friend grocer, here are some excellent sweetmeats, which I will sell you at the rate of five cents per pound; you can retail them at sixteen cents per pound, thus giving you a

pretty good profit. It is useless to add that, at such a remunerative price, it will be for your interest to sell as much of them as possible, and to stock your patrons up with them."

Then the manufacturer probably has said to himself: "My preserves stand me in two and a half cents per pound; I will sell them at five cents, thus making two and a half cents per pound. Supposing that each one of the thirty-eight millions of Frenchmen uses only one pound, I will make a fortune."

Prof. Menier, who is one of these thirty-eight millions of Frenchmen, having purchased his pound, was seized, upon tasting it, with the indiscreet curiosity to know what could enter into the composition of an article which reminded him in no wise of the fresh and savory odor of home-made preserves. He set himself then to searching for the immediate

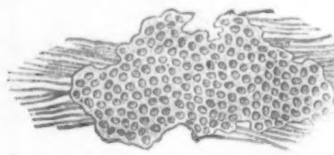


FIG. 1.—PIECE OF SEA-WEED, RECOGNIZED IN FACTITIOUS CURRANT JELLY BY THE MICROSCOPE.

principles of the currant, but without finding any of them. In fact, here are the comparative characters of genuine currant jelly, and of this strange matter:

CURRANT JELLY.	FACTITIOUS JELLY.
Consistency—Firm.	Viscid.
Color—Bright rose.	Purplish violet-red.
Acidity—Sharp.	Scarcely perceptible.
Odor—That of currants.	None.
Taste—Very sugary.	Scarcely sweet.
Ammonia changes the color to dark green.	*Ammonia* makes the red color brighter.
On calcination, an animalized odor.	No odor.

England, and which is found usually only in Japan and in the Indian Ocean; it is known as the *Arachnoidiscus japonicus*. By what miracle could the latter have made its way into these preserves, and what singular connection could there possibly be between currant jelly and a plant of the Indian Ocean? We will explain it.

In the ocean there grows a plant known as "bladder-wrack" (*Fucus*). One species particularly gives, on boiling, a sort of viscid and glutinous jelly, the consistency of which is far from reminding us of that of currant jelly, and which some families who are more economical than fond of good living substitute for the whites of eggs in making creams. To manufacture currant preserves out of bladder-wrack is an idea that would never have originated in the head of most grocers. There was, however, no doubt in regard to the article, for the object represented in Fig. 1, and as a support to the diatoms in Fig. 3, is nothing else than a bit of this same sea-weed.

FIG. 2.—POLLEN GRAINS OF HOLLYHOCK FOUND IN FACTITIOUS CURRANT JELLY.

The base being discovered, let us now pass to the color. Currant jelly is red, commonly at least. Now to color the colloid jelly, the manufacturer had only the difficulty of choice between the most varied tinctorial products—cochineal, fuchsine, aniline, alizarine, elder, etc; but, being a prudent man, it is evident that he would select the cheapest from among these things. The matter was not so easy for the chemist, who had to feel his way among these numerous substances. Fortunately, the corpuscles represented in Fig. 2 became in his hands the Ariadne's thread to guide him out of the difficulty.

One could not be a botanist and not recognize in these little spheres the pollen grains of some plant or other. Now, all pollen grains resemble each other more or less, but in certain families of plants they may be distinguished by a

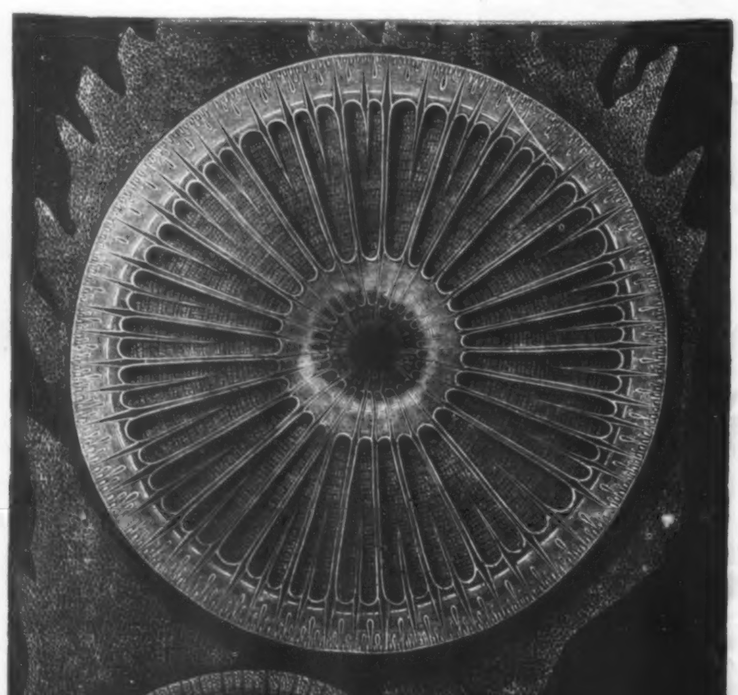


FIG. 3.—DIATOMS (*Arachnoidiscus Japonicus*) RECOGNIZED BY MEANS OF THE MICROSCOPE IN FACTITIOUS CURRANT JELLY.

Prof. Menier, convinced that currants did not enter into this product at all, then examined it with the microscope, hoping to find in it some tissues or other characteristic of the vegetable kingdom. His surprise and his pleasure as a microscopist were not a little when he found the different substances represented in the accompanying engravings (Figs. 1, 2, and 3).

Doubtless, all these things would tell the majority of our readers nothing, but to Prof. Menier it was a revelation. Especially was he astounded on recognizing a marine plant of the diatomaceous family of *algæ*, and one of the rarest species, which has been detected but once on the coast of

pretty sure character, and one which in the same genus exhibits great fixity—and that is the dimensions. The pollen of certain plants is minute, in others again it is very large; this was what was found in the present case. On measuring it, Prof. Menier became satisfied that it was the pollen of some of the order of *Malvaceæ*, and in comparing it with other grains derived from known flowers he saw that it was manifestly the pollen of the hollyhock (*Althea rosea*). In order to brighten the color, which made from the hollyhock alone would have been too dark, the manufacturer had added a small quantity of cochineal, the presence of which Professor Menier recognized by very delicate tests.

Now water, sea-weed, and hollyhock are not enough to make sweetmeats—sugar is also necessary. Ever guided by the same principles, the author (who must have meditated over Milne-Edwards' celebrated law of economy), finding sugar too expensive, substituted glucose for it—although he only put in thirty per cent.—about as little as he possibly could. Cane sugar was absolutely wanting.

Finally, to complete the picture, the feeble acidity observed in this singular mixture was found to be due to an addition of tartaric acid, which is never found in currants, their acidity being due to malic and citric acids. Why was this substitution? Simply because tartaric acid is cheap and ready at hand, and citric acid is dear. The last reason necessarily excludes currants in any quantity whatever, even a minimum.

Can the substance that Prof. Menier has studied, and which continues to be sold since his publication, although under a modified title, be placed in the category of healthful and nutritive foods? Assuredly not.

Regarded from the standpoint of wholesomeness, it should be observed, too, that it does not keep well, since Prof. Menier affirms that, in *every specimen* that he examined, he found a large amount of cryptogamic products, which would indicate a process of change, and that this change was often perceptible to the taste. It is, doubtless, for this reason that the inventor was obliged to have recourse to a hermetically sealing of the tin packages.

A product such as this, then, constitutes an injurious food. Is it when fresh, at least nutritious? It is doubtful. The pectines which form the base of fruit jellies contain a large proportion of water to the few nitrogenized elements, but their incineration, at least, demonstrates that the quantity of nitrogen they contain is appreciable; while in the sea-weed jelly there is none whatever. To give a child a slice of bread covered with this mixture would be like giving it bread dipped in water that was scarcely sweet. Prof. Mercier concludes his paper as follows:

"It is not without its use, we believe, to point out these frauds wherever they are met with, and whether they interest medical art or public alimentation. This cheap currant jelly is evidently designed to attract the attention of the poorer classes, who often use it as a refreshing drink (when dissolved in water) in cases of sickness or as a daily food for children. What surprises us is that it has not sooner attracted attention, from the time that it has been impudently exposed at the doors of the majority of grocers and dealers in food products of Paris and the provinces."

THE JAPANESE NAVY.

IN the Japan Directory, for the current year, published at Yokohama, a list of the twenty-four vessels at present comprising the strength of the Japanese Navy is given. It is as follows:

"Adzuma-Kan, ironclad, screw, 700 tons, 3 guns, 500 horse power; Amaki-Kan, fourth rate, screw, 908 tons, 9 guns; Asama-Kan, third rate, screw, 1,104 tons, 12 guns, 300 horse power; Chiyoda-gata-Kan, sixth rate, 100 tons, 3 guns, 60 horse power; Fujiyama-Kan, third rate, 1,000 tons, 13 guns, training sailing ship; Fuso-Kan, twin screw, armor plated, second rate, 3,740 tons, 3,500 horse power, 12 guns; Hiyei-Kan, screw, third rate, composite corvette, 2,200 tons, 2,500 horse power, 13 guns; Hosho-Kan, fifth-rate, screw, 173 tons, 4 guns, 60 horse power; Iwaki-Kan, screw, 600 tons, 650 horse power, 3 guns (now building at Yokoska); Jinjei-Kan, P. W. Imperial yacht; Kaimon Kan, 1,490 tons, 1,250 horse power, compound engine, 8 guns (now building at Yokoska; Kasuga-Kan, flagship, fourth rate, paddle-wheel, 7 guns, 300 horse power; Keuko-Kan, fourth rate, screw training-ship, 300 tons; Kongo-Kan, screw, third rate, composite corvette, 2,200 tons; 1,500 horse power, 13 guns; Moshiun-Kan, fifth-rate, 305 tons, 4 guns, 100 horse power; Nisshin-Kan, fourth rate, screw, 784 tons, 18 guns, 250 horse power; Raidem-Kan, old, 240 tons, 80 horse power, 4 guns; Riojo-Kan, third rate, iron belt, screw, 1,459 tons, 14 guns, 280 horse power; Set'tsu-Kan, fourth rate, store-ship; Sei Ki-Kan, fourth rate, screw, 898 tons, 8 guns, 180 horse-power; Sooriu-Kan, yacht; Teibo-Kan, fifth rate, screw, 125 tons, 5 guns, 60 horse power; Tenrio-Kan, screw, 1,490 tons, 1,250 horse power, compound engine, 7 guns (building at Yokoska); Tsukuba-Kan, third rate, screw, training ship, 1,033 tons, 12 guns, 200 horse power."

DOUBLE BOATS.

WE give opposite twenty-one illustrations of patented double boats. The general construction of each plan will be understood without special description. The name of patentee and date of patent are given with each diagram.

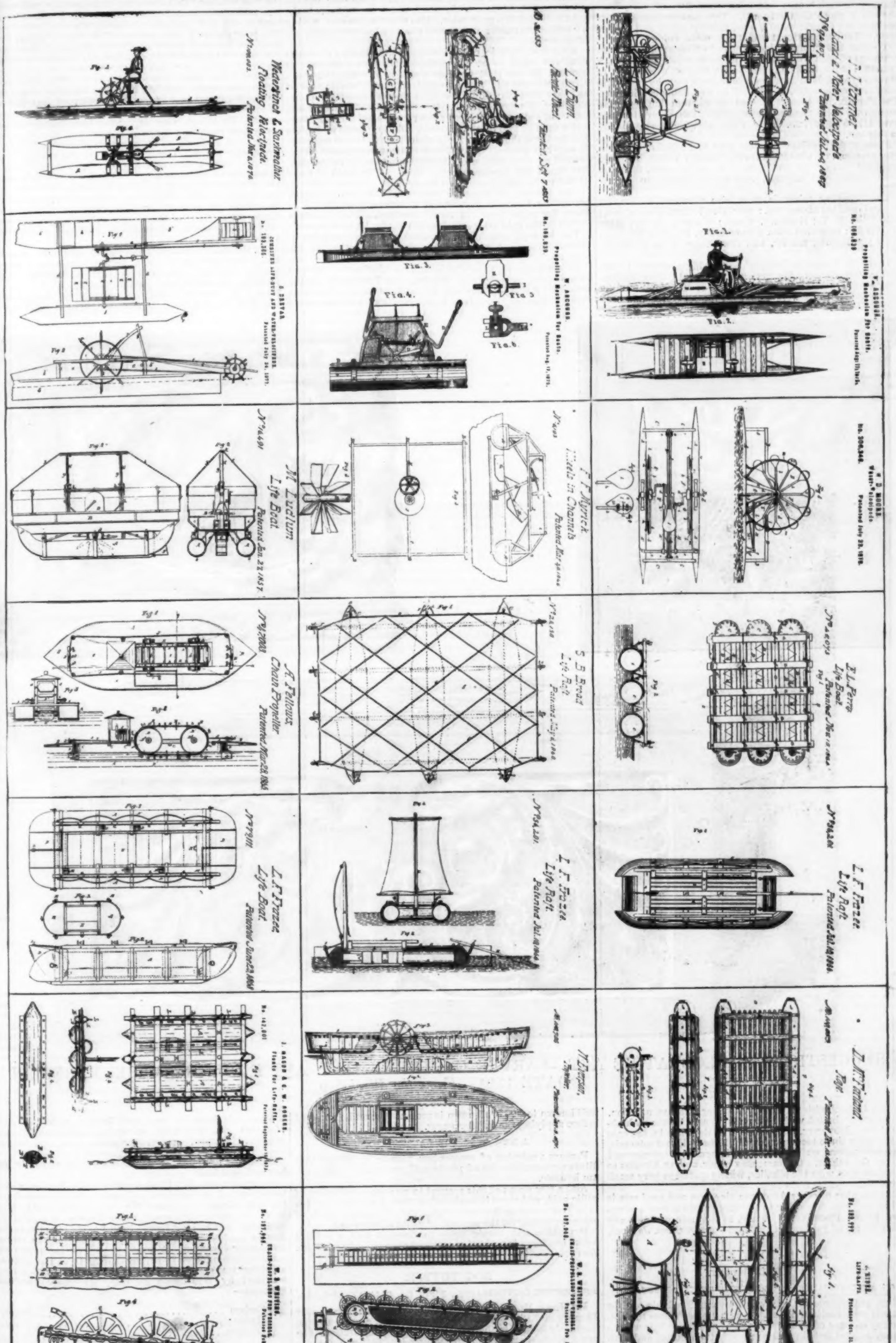
INTENSIFYING negatives by exposure to light—a plan in favor with Mr. Blanchard—is referred to in the current number of the *Archie*. A glass negative, neither intensified nor fixed, is well rinsed and put to dry in the dark. On the glass side of the plate are pasted one or more strips of paper, and it is then placed in the window with this side toward the light. In a shorter or longer time, according as the light is bright or dull, the parts of the image not protected by the paper will be found to be intensified. When sufficiently intense, the paper can be removed, and the negative fixed. In printing, the intense parts will give a much more brilliant and vigorous picture than the others.

GALLIUM IN AMERICAN BLENDES.

By H. B. CORNWALL.

HAVING observed the spectrum of the principal line of gallium, wave-length 417, I treated two European blendes and several American ones as follows. About one gramme of each was treated with aqua regia, the solutions saturated with hydrosulphuric acid, filtered, evaporated to dryness, the residues redissolved in water containing a little hydrochloric acid, and the solutions treated with sodium carbonate until a slight precipitate formed. According to Lecoq de Boisbaudran these precipitates contained the greater part of the gallium which might be present. Each precipitate was dissolved in hydrochloric acid, evaporated nearly to dryness, redissolved in a few drops of water and observed with a single prism spectroscope and an induction spark from a coil capable of giving a five centimeter spark, but worked with a battery developing only about two-fifths of the power of the coil. Separate electrodes and glass tubes were used for each blende.

One European blende, from Pierrefitte, of medium richness according to de Boisbaudran, showed scarcely a trace of the gallium line; the other European specimen, from Santander, classed among the richest in gallium, showed it distinctly. The compact, grayish blende from Friedensville,



DOUBLE BOATS.

Pa., showed it about as plainly, while a crystallized, rather dark, yellowish-brown specimen from Phœnixville, Pa., showed it more distinctly still. Two measurements of its position were made with a cross-hair eye-piece and vernier scale. They gave 416·92 and 417·05, mean 416·98.

To test the comparative richness of these blendes, two grammes of each were treated with aqua regia, the solutions saturated with hydrosulphuric acid, filtered, evaporated to dryness, redissolved in water containing a little hydrochloric acid, and each solution diluted to five cubic centimeters. The Phœnixville blende showed the gallium line distinctly enough for approximate measurement. Two determinations gave 417·20 and 417·28. None of the other blendes responded to this test.

Finally, the gallium line was seen in a solution of about one gramme of the Phœnixville blende, which had been prepared simply by treatment with aqua regia, filtration from undissolved sulphur, and concentration to a few drops.

The following minerals were also examined by the first method detailed above, viz.: zinc blende from Joplin, Mo.; Ellenville, N. Y.; Roxbury, Conn.; Warren, N. H.; Mine Hill, N. J.; calamine from Friedensville, Pa., and Sterling, N. J.; willemite, zincite, and franklinite, from Franklin, N. J.

There is reason to believe that gallium occurs in the blendes from Joplin, Warren, and Ellenville, since its line was seen more or less distinctly in case of each, and although the same electrodes were here used for all which had been previously used with a slightly stronger gallium solution, yet they were boiled with hydrochloric acid before each observation. Moreover, no gallium was detected in the case of the other three blendes and all of the oxidized minerals, the observations on which were irregularly interspersed among the others. Gallium may occur among blendes as rubidium does with the alkalies, widely spread in very small quantities.

Examination of other American zinc ores and products is still in progress, according to the simple and severe test applied to the Phœnixville blende, to ascertain whether any richer source of gallium exists here.—*Amer. Chem. Journal.*

LABORATORY NOTES.

By WM. L. DUDLEY.

ON A MODIFICATION OF BÖTTGER'S TEST FOR SUGAR.

THE importance of an expeditious and reliable test for sugar is well understood, and in many cases where the presence or absence of sugar is of vital importance it is well to employ several tests in order to verify the results; and with this end in view I have been conducting some experiments with the bismuth test.

Böttger's test, which employs subnitrate of bismuth and sodium carbonate or sodium hydrate, is a good one; but the subnitrate is liable to contain silver, which on exposure to the light will give it a gray color. Also other impurities, having a tendency to render the results more or less unreliable, are often present.

After considerable experimenting the following modification was found to be very reliable: Dissolve subnitrate of bismuth in the least possible quantity of chemically pure nitric acid, and add to it an equal amount of acetic acid of ordinary strength; dilute to eight or ten times its volume, and filter if necessary. To the solution to be tested add sufficient sodium hydrate to render it strongly alkaline, then add a drop or two of the bismuth solution; heat to boiling and continue the boiling for a short time (20 to 30 seconds). If sugar is present, the white flocculent precipitate which formed on the addition of the bismuth solution to the alkaline liquid will become gray or black. The depth of color of the precipitate depends on the amount of sugar present. If the amount of sugar be very small the gray or black precipitate forms slowly, and it is necessary to allow it to stand for some time (10 or 15 minutes). This reduction occurs in the cold after standing quietly for 24 to 48 hours.

The bismuth solution will remain unaltered, and can be diluted to any degree without the precipitation of the bismuth.

In comparative tests with solutions of glucose, this test proved quite as delicate as Fehling's or Trommer's copper tests, and it undoubtedly can be used in many cases with great advantage, especially in conjunction with the above well-known tests. If albumen is present it must be removed before applying the test for sugar.

A NEW TEST FOR GALLIC ACID.

Prepare a solution of ammonium picrate by adding to a dilute aqueous solution of picric acid, an excess of ammonium hydrate.

Add a few drops of this reagent to an aqueous solution of gallic acid, and there is produced, at first, a red color, which in a few seconds becomes a beautiful green; the depth of color depending on the amount of gallic acid present.

Pyrogallic and tannic acids produce, at first, a reddish color, but there is no further material change.—*Amer. Chem. Journal.*

BOG BUTTER.

BOG BUTTER (BUTYRELLITE), FROM CO. GALWAY, IRELAND.

MR. JOHN PLANT, F.G.S., exhibited to the Manchester Literary and Philosophical Society a piece of a mineral resin familiarly known in the west of Ireland as Bog Butter. The lump weighed exactly fourteen ounces. It came from a good depth in a bog in County Galway. A few years ago, when in that part of Ireland, he had been unsuccessful in meeting with a sample of this curious substance, although he was informed that it was not unfrequently met with by the turfcutters during each summer. He heard of its origin and of some of the uses to which it was said to be put by the poor people if they got any of it, from a farmer at Kilkee, but he could hardly credit the statement that in hard times it was melted down and actually used as a dripping to the potatoes; he rather concluded that the greasing was limited to the axles of the potato cart. The Irish have a widespread belief that bog butter was hidden by the fairies in the bogs long ages ago; and it is affirmed that the butter is sometimes found in small wooden kegs in bogs along the coast. These kegs, they say, have been hastily buried by smugglers running a cargo of contraband, though when bog butter was declared an illegal article of trade in Ireland they are unable to say. Unfortunately, Mr. Plant was not shown a keg, or even a stave of a keg, but he was informed that specimens of veritable kegs of bog butter are to be seen in the Museum of the Royal Irish Academy and in the museums at Edinburgh. The fairy origin of the bog butter he thought might be ascribed to the active imagination of the Celtic brain, many of the inexplicable things in nature being readily put down to the good or evil doings of the indigenous fairies of Erin.

By the aid of scientific analysis the substance called bog butter can be shown to be a perfectly natural production arising from the decomposition of the vegetable matters forming the peat or bog, and to belong to the numerous family of mineral resins, or hydrocarbon compounds of which Dana describes the composition of seventy species.*

Many of these are very well known under the names of marsh gas, petroleum, ozokerite, asphaltum, naphtha, paraffin, bitumen, amber, torbanite, coal, and its varieties.

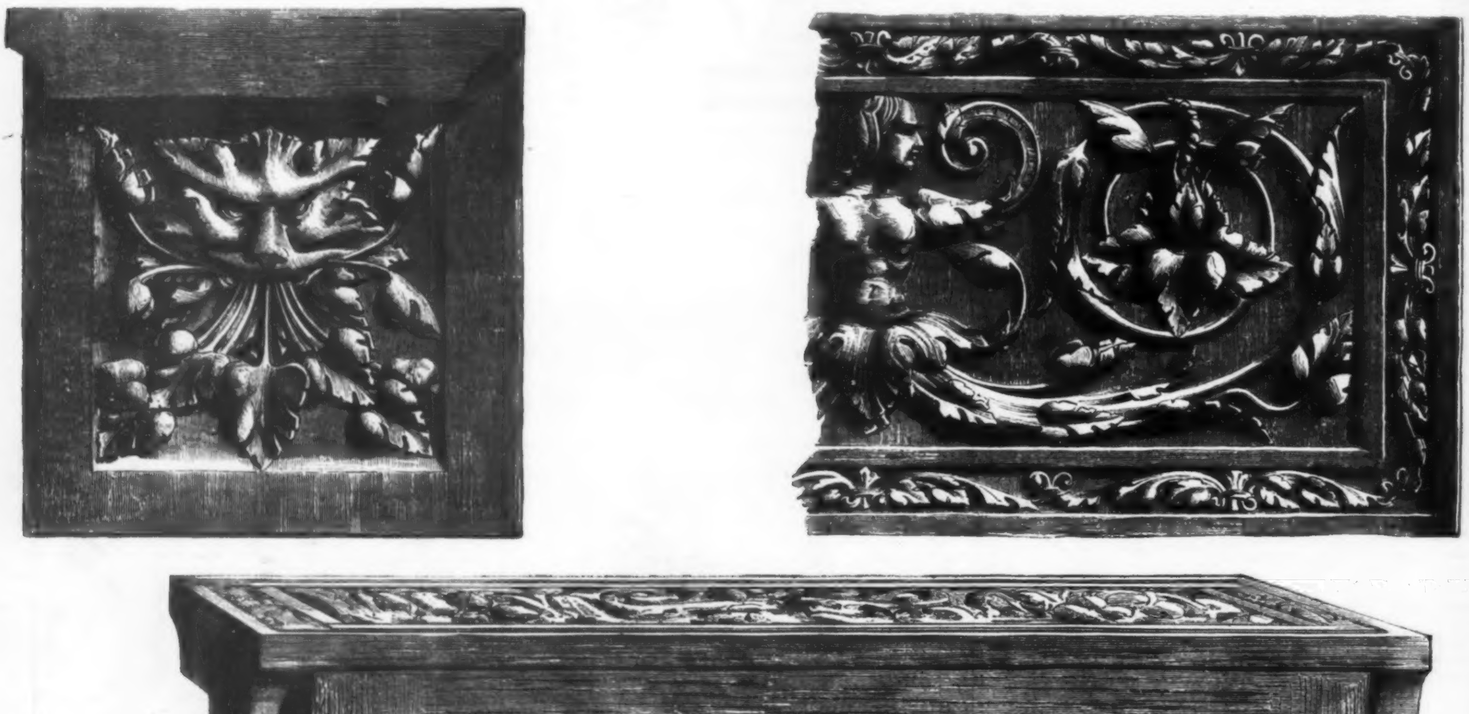
Some of these singular minerals are obtained only from bog and peat beds.

Some time ago, Mr. Plant showed to the Section a quantity of one of these resinous minerals, which occurred under the bark of pine logs found in a moss at Handforth by Mr. P. G. Cunliffe. It proved to be known in Germany as Fichtelite, but had not before been known to occur in Great Britain. Afterwards it was found in pine logs in the peat on Lindow Common. A waxy, greasy, or butterlike character is distinctive of these bog products. The one now exhibited was described first by Brazier in 1825, and was analyzed by Williamson in 1845, its composition being given as—

Carbon	73·78
Hydrogen	12·50
Oxygen	13·72

When fresh from the bog it is soft and like butter, but hardens in drying. The mass is dirty and bogstained on

* Dana, "System of Mineralogy," 5th edition, 1875, pp. 720-760.



SUGGESTIONS IN DECORATIVE ART.—CARVED CASKET IN OAK, ART INDUSTRY MUSEUM, BERLIN. DATE 1540.—*From the Workshop.*

the outside, but inside pure white and free from impurities. It melts at 50° C., and becomes a yellow greasy resin, dissolves in alcohol or in ether, and then crystallizes in beautiful needles. When heated it gives off a peculiar odor like acroline. By saponification with potash it yields an acid which Brazier proves to have a composition similar to palmitic acid.

There is a mineral waxy resin called Guyaquillite, which is found in extensive deposits in the marshy plains near Guyaquil, in South America, which has a similar composition to bog butter.

Johnson gives it as—

Carbon	76·67
Hydrogen	8·17
Oxygen	15·16

It has been proved that the slow decomposition or change in the vegetable peat or moss will produce elements of which these hydrocarbons are made.—*Chemical News.*

THE NEWER ARTIFICIAL COLORING MATTERS DERIVED FROM BENZENE.*

By R. J. FRISWELL, F.C.S., F.I.C.

Methyl Aniline Violets.—It is, no doubt, well known to many here that the earliest violets obtained by artificial means were those produced by the action of pure aniline, or phenylamine, on roseine, in the presence of an organic acid. A study of this reaction by Hofmann led to his discovery of the action of the iodides of the alcoholic radicals, methyl and ethyl, on roseine base, with the production of the well-known "Hofmann violets." These were found to be substitution products of rosaniline, in which one, two, or three atoms of hydrogen in the molecule are replaced by the radicals methyl or ethyl, according as the iodide of either has been used.

Now roseine itself is, as is well known, produced by the action of arsenic acid or other oxidizing agents on a mixture of aniline and toluidine. The chemical formula then adopted for it led to the conclusion that it was produced by the coalescence of the residues of two molecules of toluidine and one of aniline, thus:

$$C_6H_5NH_2+2C_6H_4CH_3NH_2-H_6=C_{20}H_{19}N_3.$$

O. and E. Fischer have recently shown that this formula was partly erroneous, and that the reaction could also occur between two molecules of aniline and one of paratoluidine—

$$2(C_6H_5NH_2)+C_6H_4CH_3NH_2-H_6=C_{19}H_{17}N_3;$$

but this does not affect the inference drawn from what was, till recently, supposed to be the constitutional formula of the body in question, and this inference was that the methylated derivatives of roseine could be obtained by the oxidation of the methylated derivatives of aniline, just as roseine was by the oxidation of aniline and toluidine. The inference was somewhat rash; the methyl groups in dimethylaniline replace the hydrogens in the amido group, and on oxidation might, perhaps, be destroyed. However, on oxidation dimethylaniline did, indeed, produce a very brilliant violet color, which, having been discovered by M. Lauth, and improved and patented by Messrs. Poirrier and Chappat, was introduced into commerce under the name of Paris violet. This achievement led to a demand for the production of the methyl anilines on a large scale, and, in a very short time, this was attained. It was well known that methylaniline could be produced by the action of methyl iodide, or bromide, upon aniline, the dimethyl compound resulting from the use of two molecules of the alcoholic compound; thus

$$C_6H_5NH_2+2(CH_3I)=C_6H_5N(CH_3)_2+2HI\cdot$$

but it was evidently necessary to produce the required compound in a cheaper way. This was eventually done by heating aniline hydrochloride and methylic alcohol together under pressure, in strong cast-iron vessels, enameled inside, and known as "autoclaves." Various proportions of the bodies have been employed—among others, the following giving good results: Aniline, 33·6; hydrochloric acid, 37·9; methylic alcohol pure, 28·5; heat to 250° C. for eight hours. Messers. Poirrier have also employed a mixture of 100 parts aniline and 250 methyl nitrate. In the latter case the mixture requires only a temperature of 100° C.; but the alcoholic nitrate is an exceedingly dangerous compound to deal with; in all probability it was the one that led to the lamented death of Mr. E. T. Chapman, and a very disastrous and fatal explosion at Messrs. Porrier's works was also caused by it.

Methylaniline is now largely made by the action of methyl chloride on aniline. As is well known, the former body has of late years been obtained in immense quantities in France, from a product of the destructive distillation of residues obtained in the manufacture of beet sugar. This body reacts upon aniline just as the corresponding iodide or bromide does; it is cheap, the reaction takes place with ease, and a remarkably pure product is produced: in fact, dimethylaniline can now be obtained by the ton, free from unaltered aniline, and containing only 3 per cent. of the monomethylated compound.

From dimethylaniline the violet is obtained by oxidation; formerly, various oxidizing agents were used, among them a mixture of iodine and potassium chlorate; it is, however, now well known that very gentle oxidizers will produce the color if a metallic salt is present, the one preferred being copper. If I heat, in this tube, some copper filings with a mixture of dimethylaniline and chloral hydrate, the whole will shortly become a mass of semi-solid violet. It is, however, obvious that so costly a method could not be employed on a manufacturing scale, and, accordingly, the following process is in very general use: Twenty parts pure crystallized cupric nitrate are dissolved in 20 parts of acetic acid; some common salt is now stirred into the mixture, which is carefully cooled down to the ordinary temperature, and 50 parts of dimethylaniline are added; the whole is then thoroughly mixed with about 250 to 300 parts of white sand and the stiff mass thus produced is moulded into large cakes two feet long by fifteen inches wide, and four inches thick; these, arranged on copper plates, are placed in a chamber, and heated to a temperature of 60° C. for 48 hours. At the end of that time, they have become perfectly hard and brittle and of a bright brassy color. They are broken into a coarse powder and thrown into water, sulphide of sodium being added until the whole of the copper-salt has been decomposed. The mass is now washed with water and extracted with dilute hydrochloric acid at a boiling temperature. After partial cooling and filtration, to remove some resinous by-products, the coloring matter is precipitated with common salt, and, after drying, it is ready for use. The sand, which simply serves to spread the mixture over a large surface, can be used for a fresh operation.

The product thus obtained is very brilliant in color, and in shade is that known as 3 B, dahlia, etc.; it is, however, not the bluest that can be produced. The bluest shades are made by dissolving it in alcohol, converting it into base by the cautious addition of caustic soda, and then heating the alcoholic solution of the base with benzyl chloride—a body having the formula $C_6H_5CH_2Cl$, and produced by the action of chlorine on toluene. The spirit and unaltered benzyl chloride are recovered, and the basic color, on conversion into the hydrochloride, is ready for use. In a similar way, by the action of methyl chloride, the well-known methyl green was produced; it is now, however, replaced by the malachite green, discovered by Oscar Doebner, and produced by the action of molecule of benzoyl trichloride, $C_6H_5CCl_3$, on two molecules of dimethylaniline or of benzoylhydride, or bitter almond oil, C_6H_5COH, on the same in the presence of zinc chloride or of sulphuric acid.

The latter color much surpasses the former in fastness and power of standing rough treatment in the dyeing process. The mythl, and, still more, the iodine green obtained during the manufacture of blue shades of Hofmann violet, were fugitive and easily altered by heat, so that the latter could not be boiled without changing to a violet.

Before leaving the methylaniline colors, I may briefly allude to a question of scientific interest in connection with them. It is well known that Hofmann himself, at one time, considered the violets obtained by the methylation of rosaniline and those from methylaniline to be identical. On the other hand, there was much evidence against this view, for the methylaniline color was readily rendered bluer in shade by benzyl chloride, which was almost without action on the Hofmann one; it was also more brilliant, had a much greater affinity for animal fabrics, and was less permanent when exposed to light. For these reasons, the Hofmann color is still in demand, and, indeed, has recovered some of the ground it at first lost to the more brilliant color. The researches of Brunner and Brandenburg, following those of Caro and Graebe, have shown that the methylaniline violets are not identical with those obtained by Hofmann's process.

Diphenylamine Blue and Alkali Green.—The ordinary aniline blues are obtained by the action of aniline upon roseine base, in the presence of an organic acid, at a temperature which ultimately approaches the boiling point of the aniline used. The ultimate product of this reaction is an exceedingly intense blue, the hydrochloride of which is known as opal blue, and is, really, the hydrochloride of triphenylrosaniline. This, on dry distillation, yields diphenylamine, and the latter body, on oxidation, yields a blue which is identical with that obtained from rosaniline, but somewhat greener in shade, and is therefore in demand for certain uses. The diphenylamine is prepared by heating, under pressure, a mixture of aniline and dry aniline hydrochloride, when the following reaction occurs:

$$C_6H_5NH_2+C_6H_5NH_2HCl=(C_6H_5)_2NH+NH_4Cl.$$

Diphenylamine is readily oxidized if heated with oxalic acid, and the resulting melt, purified from unaltered oxalic acid, diphenylamine and resinous matters, is readily converted into either of the sulphonic compounds discovered by Nicholson. Blues of a redder shade can be also obtained by the oxidation of methyl or ethyl diphenylamine.

I have now to call your attention to a green obtained from this body, discovered by Mr. R. Meldola, and now under his investigation. It is obtained by the oxidation of a diphenylamine derivative. After oxidation the color is obtained in a state corresponding to the well-known opal-blue, and, like that, forms sulphonic acids. It is remarkable as being the first green obtained having this property. The sodium salt of the sulphonic acid is soluble in water, and, if wool is immersed in this solution (which is nearly colorless), and kept warm, it apparently undergoes but slight change. I have here a piece of Berlin wool which has been thus treated, and subsequently dried. You will observe that it is, apparently, only rather dirtier than undyed wool. When, however, I immerse it in warm water, acidulated with sulphuric acid, a brilliant green is immediately developed. The color is remarkably fast; and, since it requires exactly the same dyeing process as do the Nicholson blues for wool, one would have supposed that it would have been much liked by the dyers; but this is not at present the case. It was exhibited at the late Paris Exhibition by the firm of Brooke, Simpson, and Spiller.

As time is getting on, I must now leave this very interesting field—the colors produced by the oxidation of the secondary and tertiary amines—after a very brief and incomplete glance at a few of them, and pass on to the consideration of a totally distinct group of coloring matters, which are now attracting much attention in color-chemists' laboratories, and which have already taken an important place among artificial dyes, though, as yet, the range of shades is somewhat limited. These are obtained from substances produced by the action of nitrites on amido compounds, and are known as the azo-yellow, oranges, and scarlets.

The effect of nitrites on organic compounds is very various according to the subsequent treatment they undergo: thus, if nitrous gas is passed through a solution of diphenylamine in acetic acid, a mixture of nitroso-nitro-diphenylamines results; and this, on heating with an alkali, decomposes so far as the nitroso groups are concerned, and a mixture of mono and dinitro diphenylamine results, which was introduced as a yellow dye by Mr. R. Meldola. A somewhat similar reaction occurs if the sulphonic acid of alpha naphthol is similarly treated, and dinitronapthol may be obtained while, if a nitrite is added to an aniline salt, and the resulting compound boiled, or if rosaniline salts are similarly treated, the whole of the nitrogen is eliminated with effervescence, and phenol in the one case, rosalic acid in the other—both of them non-nitrogenous substances—result. Before this boiling takes place, there are, however, in the two latter cases very different bodies in solution; these bodies, which behave in the manner just mentioned on boiling, are known to chemists as "azo compounds."

In the earlier days of organic chemistry, the prefix "azo" was applied by Mitscherlich, Laurent, Zinin, and others to many bodies containing nitrogen, such as azo-benzene, $C_6H_5N=NC_6H_5$, produced by the imperfect reduction of nitro-benzene, and also to others, like the compounds obtained by Laurent by the action of ammonia on bitter-almond oil and other bodies. In 1864, however, P. Griess published a magnificent memoir, in which he described a number of bodies obtained by the action of nitrous acid on aniline, and various substitution products obtained therefrom. In this paper, he proposes that the prefix "azo" should be held to mean that the compound to which it was applied contained one atom of nitrogen occupying the place of one atom of hydrogen. This definition is now generally accepted, and thus the term "azo" has obtained a definite signification.

The azo compounds are, as a rule, very easily prepared; in most cases, it is only necessary to add a solution of metallic nitrite to an acid solution of a given amide, in order to obtain the diazo compound of the radical contained in the amide; thus, if I take a solution of aniline hydrochloride, and add to it an equivalent quantity of sodium nitrite solution, the reaction at once takes place, and diazobenzene is produced; it can be readily separated from its solution, and obtained in the solid state, one method being to add a solution of potassium dichromate when the chlorochromate of diazobenzene is produced. This salt, when dry, is terribly explosive, and at one time was suggested for use in warlike operations; however, it very rapidly decomposes when kept losing nitrogen, and becoming no longer efficient.

This explosiveness is readily understood when we consider the constitution of the body which contains the group —N=N—. It is manifestly in a state of unstable equilibrium and a very slight disturbance is sufficient to bring about its decomposition; and, for the same reason, you will at once see that its chemical activity, as measured by its tendency to combine with other bodies, will be great; so that if I add to it another molecule of aniline salt, or, what amounts to the same thing, if I add to two molecules of aniline only one of sodium nitrite, the diazobenzene formed at once attacks the free aniline salt, and what is known as diazoamidobenzene is formed, which, in the presence of an aniline salt, becomes amidoazobenzene—$C_6H_5N=NC_6H_4NH_2$. The oxalate of this body was once in pretty general use as a yellow dye, but, as it happened to be volatile at a very low temperature, it soon evaporated from the dyed article, and was, therefore, discarded.

A compound having a very similar constitution and mode of preparation has, however, long been in use, and is one of the most permanent of the aniline colors, under the name of "Bismarck Brown." It is obtained as follows:

Metadinitrobenzene is prepared by boiling ordinary nitrobenzene with nitric acid. The compound thus produced is added cautiously, with constant agitation, to coarse iron borings, kept boiling in a large quantity of water acidulated with hydrochloric acid. A violent reaction soon commences (I could readily show you the experiment, but for the steam and unpleasant odor produced); the four oxygen atoms contained in the dinitrobenzene are replaced by hydrogen, thus:

$$4C_6H_4(NO_2)_2+Fe_{15}+4OH_2=4C_6H_4(NH_2)_2+5(Fe_3O_4).$$

We have thus produced diamidobenzene, and this, when purified from a little dissolved iron, is attacked with sodium nitrite solution; the reaction here is analogous to the one last described, the final product of the reaction being a triamido-azobenzene, the hydrochloride of which constitutes the well-known coloring matter. We have thus two terms of a possible series—first, the amido-azobenzene (yellow, volatile, and fugitive), and triamido-azobenzene (brown, and perfectly fast). Dr. Witt set himself the task of filling up the intermediate link, expecting an orange color, and a moderate stability for the diamido-azobenzene he sought. In this he was not disappointed. A study of the two compounds, from a purely scientific point of view, led him to a perfectly accurate prediction; and the discovery of "chrysoidine," as the new color was called, and its production—by the addition of diazobenzene chloride to a solution of diamidobenzene—was one of the first of a series of researches which have, in various hands, enriched our science and our dyers with a number of magnificent colors.

The further development of these colors commenced with the introduction of a sulphonic group into one of the amido compounds, the conversion of the sulphonic acid thus produced into a diazo body, and then using it as before; for instance, if sulphanilic acid—produced by the action of strong sulphuric acid on aniline—is converted into diazosulphanilic acid, and this added to a solution of diamidobenzene-hydrochloride, the scarlet body produced is the sulphonic acid of chrysoidine. Again, the same body will act on resorcine to produce a color only differing from the last in that it contains hydroxyl instead of amido groups; this body has been used as a dye, under the name of Tropæoline O. Witt also produced, by substituting diphenylamine for the resorcine, or diamidobenzene, another beautiful orange, known in commerce as Tropæoline OO. Other compounds were subsequently prepared, and have obtained greater prominence; these were those in which a naphthol was substituted for the phenolic or amido portion of the molecule, beautiful oranges being produced by the action of diazobenzene sulphonic acid on both α and β naphthol; but these colors were much improved by the introduction of sulphonic groups into both portions of the molecule, α or β naphthol-sulphonic acid being, in fact substituted for the naphthol only; still, so far, the improvement was in the direction of stability mainly, the shades still being yellow or orange; the red was yet to come.

Chemists will not be surprised to hear that the higher homologues of benzene are found, when converted into amido compounds, to give an increased redness of shade; thus, with a given phenol or amine, diazosulphotoluidinic acid, which differs from diazosulphanilic acid by having an atom of hydrogen in the benzene ring replaced by methyl, gives redder shades than does the latter, while the substitution of another hydrogen in the same way, as is the case with the diazo compound derived from sulphoxylidenic acid, produces a scarlet. Messrs. Meister, Lucius, and Bruning were among the first to produce a scarlet by this method, but they also introduced both the sulpho groups into one side of the molecule—that of the naphthol. In their patent they describe the preparation of two isomeric beta naphthol-disulphonic acids, the sodium salts of which are differently soluble in alcohol, the most insoluble one giving a redder color than the other. On one or other of these they act with diazoxylene chloride, produced by the action of a nitrite on xylidine chloride. The most insoluble salt above mentioned gives a scarlet closely approaching cochineal, and perfectly fast.

Mr. R. Meldola has also taken out a patent for a scarlet, in which no less than three sulpho groups are engaged. He prepares diazosulphoxylidenic acid; and with this acts on β naphthol disulphonic acid; on the addition of ammonia, the color is immediately thrown down, as you perceive. This is, after a slight purification, ready for use. By certain modifications, a scarlet, closely approaching the scarlet obtained by dyeing cochineal in the presence of oxichloride of tin, is produced.

So far, we have only oranges and scarlets by these reactions. Whether other colors can be similarly produced remains to be seen; but I may mention that Mr. Meldola has recently communicated a paper to the Berlin Chemical Society, in which he describes a violet color—unfortunately not a dye—obtained in a somewhat similar way. If we act on dimethylaniline—the body from which the violets described in the first part of my lecture are derived—with a

* A recent lecture before the Society of Arts, London.

nitrite—not an azo, but a nitroso dimethylaniline, is produced thus: $C_6H_4NON(CH_3)_2$. This body is as ready to combine with others as an azo body is, and does so in a very similar way, the oxygen atom being eliminated in the process, so that if we act with it on β naphthol the following combination takes place:*

$$\begin{array}{c} C_6H_4.N.N(CH_3)_2 \\ \| \\ \beta C_{10}H_6HO \end{array}$$

The oxygen of the nitroso group going off with two hydrogens from the β naphthol, the place of which is taken by a group, which is equivalent to azo-dimethylaniline. The color crystallizes magnificently, but its dyeing powers are very feeble.

I must now conclude a very imperfect sketch of some of the recent advances of color chemistry. If I have succeeded in showing some that practical results do come from purely scientific researches, I am content. Hard things are often said of the aniline dyes; they are looked on as poisonous and fleeting. The first accusation is untrue, properly used they are perfectly harmless. The second is only true of some few of the series, and many of the older dyes are equally evanescent, while none are so beautiful and brilliant—though this may be considered a fault, for some highly æsthetic persons look on the producer of brilliant colors almost as a criminal.

The color-chemist may contemplate all these hard sayings with an even mind. In the humble position of a scavenger, he takes some of the most noxious waste products of our civilization, those produced in the gas manufacture, and converts them into useful and beautiful coloring matters. If these are improperly applied to the cloth or fabric, that is not his fault; while if they are inartistically used, our æsthetic friends have the remedy in their own hands.

DISCUSSION.

Mr. Spiller was much pleased to be able to express his obligation to the reader of the paper for what he considered to be a very good account of the latest outcome of the benzene color industry. It would be manifest to the audience, although they might not in every particular have been able to follow the theory of the matter, or understand all the hard names, that this benzene dye industry had, of late years, made gigantic strides. From his own connection with this class of work for ten or twelve years, he was able positively to say that the number of new coloring matters gained within that period was considerable, and he would put it on a more forcible basis than even Mr. Friswell had done, and say that, at the time when he first occupied himself with this work, it was the rule to select out the benzole of the coal-tar and naphtha, and throw away a large residual product which was then known as dead-oil. As its name implied, dead-oil would manifestly be a waste product thrown away, or used for confessedly inferior purposes. But the requirements of the latest forms of coloring matter, those which had just been mentioned, particularly the orange and scarlet, demanded that a certain quantity of the dead-oil should be worked with a view to extract from it these materials which were formerly worthless. For instance, it was necessary to save toluene, and also to save for the purposes of manufacturing the new scarlets, the xylene. These were now economized. And they were also making considerable strides toward working up naphthaline. Now, naphthaline had, for a great number of years, been a perfect bugbear in scientific industry. It was produced in immense quantities in the manufacture of gas, and whilst anthracene had been, by the labors of Perkin and Graebe, admirably employed in the manufacture of artificial coloring matters, which were substitutes for madder, naphthaline, the lower term in the series, had been thrown away. But, however, they had a chance of using it in the production of the beautiful colors brought forward that evening, particularly the scarlet, one of the colors which had been so well described by Mr. Friswell.

Dr. Armstrong, F.R.S., said he did not know what right Mr. Friswell had to speak of coal tar as a noxious product. He thought that it was harmless when left alone, and Mr. Friswell had shown, when properly treated, it was capable of exhibiting itself in a very different light. The paper he had read ought to convey a very sound lesson to the objectors to abstract science, because they knew very well that, practically speaking, the whole of these colors were the result of investigations originally undertaken entirely without any practical aim. Chemists were led to investigate these various substances from pure love of their science, with the object of learning more about them, and, in the course of a very brief period, their discoveries had acquired an enormous practical value. He should not be far out, probably, in saying that, at the present time, with the exception of indigo, nine-tenths of the coloring matters used were artificial, produced from coal-tar, and that fact ought to be encouraging to holders of gas shares. There was a large amount of material still remaining in coal-tar not utilized, and there was, no doubt, a great future in that direction. These colors, which Mr. Friswell had spoken of in particular, afforded a striking illustration of the advantage of working on these subjects and taking no heed whatever of the objections raised against chemists using long names and complicated formulæ. It was not more than ten or twelve years ago that it was found that alizarine and Turkey red could be produced artificially, and now practically all the Turkey red which was used was made artificially. A few years ago the substances used in the preparation of these colors were substances which even chemists were almost afraid to handle. Those so-called diazo compounds, originally discovered by Dr. Griess, were very difficult to manipulate, and extremely unstable; and even chemists would have laughed at the idea of using such unstable compounds for the preparation of coloring matters on a large scale. One feature was of particular interest, namely, that the great part of this work had been the outcome of theoretical views. The work of Dr. Witt, to which allusion had been made, was entirely such. He had formed certain ideas with regard to the theory of the constitution of coloring maters, that coloring matters ought to be bodies having certain constitutions, and he set himself to work to prepare bodies having certain constitutions, and realized his ideas, and still more chemists were rapidly getting a distinct notion of the theoretical constitution of coloring matters, so as to be able to say not only that a certain body would be a coloring body, but would have a certain shade.

Mr. Meldola said he cordially sympathized with the remarks which Dr. Armstrong had made, as to these valuable discoveries being the indirect outcome of researches, undertaken from a purely unpractical point of view; but, although Dr. Armstrong would lead many present to suppose that the science had arrived at that happy state when we could predict, to a certain extent, what colors would be produced by certain compounds, he must say that, speaking practically, they had not yet arrived at that happy position. In fact, it was owing to the great doubts which still surround many of the reactions, that new coloring matters had been produced. It was not possible to start from a given point of view and say you would produce colors of a particular hue. There was no doubt that a great many of the products that now run down our drains would one day become quite as valuable as many of those which were employed in factories, and which gave rise to these coloring matters. The complex formulæ of diazo compounds having been referred to, must be his excuse for making a few more remarks on the same subject. Mr. Friswell had explained how diazobenzene chloride, for instance, acting upon another benzene nucleus containing in either an amido or phenolic group, the two benzene nuclei became linked together by the diazo group, giving rise to a complex molecule such as constituted the substance of these oranges and scarlets. The beginning of these substances was Dr. Witt's "chrysoidine;" by acting on metadiamidobenzene with the chloride or any other salt of diazobenzene, Dr. Witt produced $C_6H_5N_2,C_6H_3(NH_2)_2$, and you had two benzene nuclei grouped together by the diazo group. There had recently been another step made in this direction, and W. von Müller had described colors built up on this type, plus the addition of another benzene nucleus. Taking the ordinary aniline yellow, amidoazobenzene, he showed that two molecules of hydrogen could be taken out and replaced by nitrogen and another benzene nucleus thus attached, so that the formulæ of these diazo compounds were becoming more and more complex every day, and their number might go on increasing indefinitely. The whole subject illustrated very well the truth, that in the opinion of the chemist there was no matter which might not some day be turned to useful account; and very often the products which were at one time most despised suddenly became famous.

The Chairman said he had now a pleasing duty to perform of proposing a vote of thanks to Mr. Friswell, and he regretted it had not fallen to the lot of Mr. Perkin, who had gained a European renown in this form of chemistry; but, unfortunately, he had been unable to take the chair to-night, having a previous engagement. This was not a branch of chemistry with which he was sufficiently familiar to be able to take a very active part in the discussion, but irrespective of the technical points of the paper, they had learnt much. They had heard very valuable observations made by Mr. Spiller, from a technical point of view, in which he referred to the fact, now clearly before them, that naphthalene, which had been for a long time not merely valueless, but a considerable nuisance to the gas engineer, was about to yield considerable results, which might be as brilliant as those yielded by anthracene; and they must all agree with Professor Armstrong that, after all, knowledge which was subsequently to become of value in technical operations, could only be built up, not by mere empiricism, but by scientific investigation. It would be perfectly impossible for any one present to take those different bottles, and add the contents of one to the other, and expect to be able to obtain numbers of beautiful products; on the contrary, they might produce some very unpleasant results. These valuable and important bodies were not built up in that empirical way. They were the result of long previous scientific research; and when it was remembered that Faraday, before any of them were born, discovered benzene, and that long ago Undverdorben discovered aniline, it was evident that there must have been, from that time, a considerable amount of pure scientific research carried on before manufacturers were able at last to make use of these useful products of the coal distillation, and convert them into the valuable dyeing materials which we now possess. They had heard from the speakers that there was yet a very large and important field which had not been investigated; and inasmuch as the last fifty years, since the discovery of benzole, had produced such enormous results, more especially within the last twenty years, they might also assume that the next fifty years would utilize all, or almost all, of those numerous products which were now obtained from the destructive distillation of coal, and were at present considered useless. He had much pleasure in tendering to Mr. Friswell the hearty thanks of the meeting, for the very able and clear account he had given of the more recent work of this line of chemical activity. He had been very modest with regard to his own contributions to it, but they were indebted to him and to many others for the increase of knowledge in these matters.

* This formula is given under reserve, as a complete investigation of the compound has not yet been published.

SULPHUR IN COAL.

By Dr. W. Wallace, Glasgow.

It has been assumed that sulphur exists in coal chiefly, if not exclusively, in the form of bisulphide of iron, the presence of which can be detected in almost all varieties of the mineral. Crace-Calvert asserted many years ago that in some cases, at least, sulphur existed in coal in the form of a sulphate, and he gave a process for the estimation of the sulphur existing in this form. Some analyses which I have recently made have shown conclusively, however, that in some coals the greater part of the sulphur exists as an organic compound. These coals contain but a small proportion of iron—not nearly enough to form bisulphide with the iron that exists in them—and one well known description known as the Ell coal was found not to contain a trace of sulphuric acid when tested by Crace-Calvert's method. The others were not tested.

The following table shows the relative quantities of total sulphur and that existing as pyrites, as calculated from the iron found in the ash of the coal, assuming that all the iron exists as bisulphide, which is not always the case, as some coals contain carbonate of iron.

	Total Sulphur.	S. as Bisulphide.
Ell coal (Lanarkshire)	0·91	0·11
Main coal "	0·60	0·42
Splint "	0·46	0·14
Pyotshan "	0·68	0·17
Soft coal from Fife	0·93	0·49

The estimations of sulphur were made by Pattinson's method, and also by fusion with sodic carbonate and potassic nitrate. When carefully performed and blank experiments made to eradiate sources of error, these methods give concordant results. It is well-known that boiling with nitric acid does not give the whole of the sulphur, and I find that the amount obtained usually corresponds close with that existing as pyrites.

The following analyses of the coals referred to may be useful for comparison with English varieties, of which the composition is given in several works on chemical technology.

	Ell.	Main.	Splint.	Pyotshan.	Fife.
Carbon	71·37	67·35	70·05	72·21	61·88
Hydrogen	5·18	5·03	5·24	4·79	4·89
Oxygen	8·88	12·66	12·37	9·77	12·78
Nitrogen	1·44	1·40	1·36	1·51	1·14
Sulphur	0·91	0·60	0·46	0·60	0·93
Ash	0·91	3·60	3·80	2·74	3·92
Water at 100° C.	11·36	9·36	6·72	8·30	14·46
	100·00	100·00	100·00	100·00	100·00
Spec. grav.	1·255	1·293	1·282	1·280	1·260
Heat units, C	7,190	6,628	6,929	7,062	6,132
Heat units, F	12,942	11,932	12,472	12,711	11,037
Lb. of water evap'd by 1 lb. of coal (theoretical)—	13·20	12·18	12·74	13·00	11·21

In calculating the last figure allowance has been made for the evaporation of the water contained in the coal. Some authorities give the results of analyses of coals in the dried state, but such statements are of little practical value and are apt to mislead consumers of fuel. The water in coal, although readily expelled by heat, varies very little in samples taken from the pit at different times, and, in fact, is as constant as the composition of the coal itself, which varies sensibly in different portions of the field.—*Chemical News.*

[Continued from SUPPLEMENT No. 231, page 3684.]

PROGRESS OF INDUSTRIAL CHEMISTRY.

(American Chemical Journal.)

BRIEF REVIEW OF THE MOST IMPORTANT CHANGES IN THE INDUSTRIAL APPLICATIONS OF CHEMISTRY WITHIN THE LAST FEW YEARS.

By J. W. Mallet.

MANUFACTURE OF GLASS.

Materials.—Improvement has of late years been observable in the more general use of comparatively pure materials, even the sand being, in consequence of cheapened transportation, more carefully selected than formerly; but especially have the alkalies been obtainable in much purer forms and at lower prices. As the result of this, colorless glass has noticeably replaced for many common purposes, as in the case of most apothecaries' bottles for dispensing medicines, perfumery, etc., the coarser "green glassware" formerly in use. There has also been improvement in the pains bestowed upon ascertaining and using the best proportions of the materials with a view to homogeneity and definiteness of composition in the glass, thus diminishing the risk of "devitrification" and ready alteration of the surface of the glass in use by water or other reagents. There seems, however, to be still room for advance in this direction, both as to investigation and application of its results in practice. Of comparatively new materials used, zinc oxide in Belgium and barium carbonate in France and the north of England hardly deserve to be considered as more than experimental additions.

Furnaces.—Decidedly the most important improvement made for a long time in the manufacture of glass has been the adaptation to the special use of the Siemens regenerative furnace with gaseous fuel. Originally arranged to work with the glass pots of the types long in use, the furnace in its improved form, designed by Siemens, dispenses with the use of these vessels altogether, thereby saving much expense, labor, and risk, and provides for the complete preparation of the glass in the hearth itself, this being divided into three compartments, in the first of which the mixture of raw materials is fused, in the second glass is "fined" or cleared, and in the third it is brought down to the proper temperature and therefore consistence for working.

Except perhaps iron puddling and steel making, no application of this valuable invention brings out more prominently its peculiar merits—the continuous action, crude material going in at one end and finished glass coming out of the other; the purely gaseous atmosphere of the hearth, free from soot or ash; the extremely high temperature readily obtainable, affording the means of perfect fusion and easy separation of sand grains, gas bubbles, etc.; the effective mixture of the molten glass as it flows under and over the partition walls of the hearth; and the complete command of temperature for working purposes, both of the glass itself and of the working openings for reheating.

Processes of Glass Working.—For the production of glass in sheets for windows, the "crown glass" process of "flashing," long a distinctively English industry, has almost completely ceased to be employed, while in its place the "cylinder" process has undergone marked extension and improvement as to the scale upon which its product is turned out, the size of the sheets made by it—reaching even to 84 × 42 inches—and the smooth, even condition of the surface of the flatted sheets. Plate glass too has been brought more and more widely into use, both in the original form of sheets polished on both sides after casting, and perhaps still more largely with rough surfaces as taken from the casting table, and with flutings and other figures embossed, or perforations made beneath the roller. Immense plates, extending up to more than 20 × 10 feet, have become familiar to us, the limit of size being found in fact more in the difficulty of safely moving and setting in place such magnificent slabs than in that of originally producing them. In the manufacture of hollow ware perhaps the most noteworthy change has been the growth of the process of pressing in moulds without blowing. The development of this especially American industry has been rapid, and marked by much varied ingenuity as to the details of the moulds and other tools.

Annealing.—Beside minor improvements in the construction of kilns for ordinary annealing with movable soles or floors, a marked novelty has been the introduction by De la Bastie and others of the practice of rapid cooling of articles of glass to a temperature still much above that of the atmosphere, giving rise to the manufacture of the so called "hard glass" or "toughened glass," in the production of which the articles to be treated are, at a low red heat or a temperature just low enough to secure rigidity, plunged suddenly into a bath of heated oil, glycerine, or other suitable material.

The process of Pieper, involving exposure of the hot glass to a current of superheated but colder steam, and that of F. Siemens, forcing the glass into hollow moulds, generally of metal, kept at determinate temperatures in their different parts by the circulation of water, while actual contact with the face of the mould is prevented by the interposition of a layer of wire gauze or other material, produce essentially the same sort of effect. For some purposes the resulting great

increase in strength of the glass, its capability of withstanding greater mechanical stress and more violent blows, is undoubtedly valuable, but it seems likely that the expectations at first entertained as to the usefulness of the new product will turn out to have been exaggerated. Its unmanageable character as to any modification of dimensions, shape, or surface, by cutting with a diamond or by grinding, its complete, even dangerous, shattering when it does break, and the difficulty of securing uniform results from the tempering under varying conditions of size and shape of the articles treated, are all serious disadvantages, though perhaps not altogether incapable of being overcome by further modifications of the process. The very recent and rather startling proposal of F. Siemens to make railway sleepers of toughened glass, aside from any special difficulties or dangers, does not seem likely to be altogether free from the same objections arising from excessive jarring vibration and consequent wear and tear of rails and rolling stock, which caused the granite blocks used in the early days of railway construction to be laid aside.

Optical Glass.—The progressive improvement in this difficult branch of the manufacture, continued for a good many years past and still going on, is best evidenced by the steady increase in the size of the disks, now obtainable up to more than thirty inches in diameter, from which the largest telescope lenses are made, while clearness, uniformity, and freedom from flaws of any kind of these great lenses have also been secured in higher degree than formerly. Chemically the chief novelty in the composition of this kind of glass has been the introduction of thallium silicate into flint of unusual density, but this has been practiced upon a very limited scale only.

Decoration of Glass Work.—There has been of late years some advance in the clearness and brilliancy of colored glass for windows, but more marked results have been attained in the artistic than the technical treatment of this material. The revived imitation of the *defects* of ancient colored glass, such as embedded sand grains, air bubbles, and the like, form a curious feature of its recent history.

The imitations in glass of the various precious stones are made of late with remarkable fidelity to natural appearance, and some of the specimens sold are noticeable for a degree of hardness, much less, it is true, than is usually claimed for them by dealers, but much exceeding anything that was known some years ago.

Well deserving the attention they have received have been the beautiful products of the revived glass industry at Murano, especially the delicate "ritorto" work, depending on the plastic union of symmetrically disposed rods of variously colored glass and the twisting of the mass they produce as it is afterwards developed into the desired form. Not only under Salviati at Murano, but more recently in Austria has this mode of decoration been admirably applied to the reproductions of early forms as well as to designs of modern origin.

To the older varieties of "milk glass" or enamel has been added the "hot-cast porcelain" made by fusing together quartz sand, cryolite and zinc oxide, chiefly used so far for the rougher and less artistic articles which admit of being made from such material.

In surface enameling of sheet glass may be noted the transfer of lace patterns from the woven or netted fabric itself, used as a stencil to distribute the pulverized enamel upon the surface, afterwards to be burnt on.

The most valuable novelty in the surface alteration of glass is the process of etching by means of Tilghman's sand-blast. The simplicity and quickness of the process, the great depth to which the abrasion of the glass may readily be carried, cutting through, for instance, a flashing of colored glass or even producing complete perforation, the applicability of the method to sheets of glass so large as to be treated with great difficulty, if at all, by the older grinding-wheel or by hydrofluoric acid, and the delicacy with which the minute features of intricate designs may be engraved—admirably shown in some of the etchings of photographs upon a film of chromated gelatine covering the glass—approve the process as one of great and permanent value.

Amongst the latest modifications of glass decoration is the "iridescent glass" exhibiting a delicate play of soap-bubble colors, the result of slight chemical attack of the surface by moderately strong liquid hydrochloric acid under pressure in close vessels, or by the fumes from chloride of tin or analogous material volatilized in a reheating furnace.

The silvering of glass by deposition of metallic silver from its solutions by means of such reducing agents as glucose, milk sugar, aldehyde, tartaric acid, etc., has completely passed from the laboratory to the workshop, where it is now regularly and extensively practiced. A somewhat recent improvement consists in increasing the density of the film of silver, and at the same time removing the unpleasant yellow tinge which it is apt to have, by moistening the surface with a dilute solution of mercuro-cyanide of potassium, so as to form a silver amalgam.

Dodé's process for platinizing glass, by carefully heating it after the surface has received a nicely applied thin coating of platinic chloride mixed with one of the essential oils, has the advantage of furnishing a mirror which reflects from the front face, avoiding the double passage of light through the glass itself, while the exposed metal is not liable to tarnish. It does not seem to have been generally noticed that a simple piece of flat sheet glass treated in this way, and supported at a suitable inclination, makes quite an effective *camera lucida*, as the platinum film is thin enough to permit of the pencil and hand of the draughtsman being seen through it, while at the same time the objects to be copied are seen by reflection.

Glass drawn out into extremely fine threads—the so-called "glass wool"—has of late, in the hands of a Viennese firm, been used for decorative purposes of a better sort than the long known toys turned out at the glassblower's lamp, and has also been produced in useful shape as a material for filtration.

MANUFACTURE OF PORCELAIN AND OTHER CLAY-WARE.

It is more difficult to point out marked changes in this industry than in that of glass in matters connected with chemistry: the materials used being mixtures of more complex character, and the extent and manner of their union in the baking varying with the mode in which the heat is applied, the chemistry of both processes and products is less advanced. More attention has been given to mechanical improvements in grinding, mixing, etc., to the methods of burning, and especially to artistic expression in design and decoration. Still progress has unquestionably been made in the former direction within the last few years.

General Character of Products.—On the whole, probably the greatest improvement has been in the higher grades of stoneware and earthenware, rather than in porcelain itself. Almost the same care bestowed upon the production of the latter has of late been given to the treatment of the former, the selection of the materials, their subdivision, careful kneading together, moulding, drying, burning, and glazing. Special kinds of ware have attracted particular attention from time to time, partly from the intrinsic character of the mass, partly from the designs which it has been used to carry out, such as the revived Majolica and Persian ware of Minton and the Parian and other biscuit ware of Copeland and others. The excellent common stoneware now made, strong and capable of bearing much in the way of change of temperature and exposure to energetic chemical reagents, has done valuable service as material for many of the vessels used in manufacturing chemistry.

Mechanical Appliances.—The most valuable of these brought into use in comparatively recent times has probably been the strong and effective filter press, which has done so much good service in connection with general chemical manufactures, and which is now largely used in removing the surplus water from the clay after the process of mixing. Special features introduced in some of these presses tend to prevent as far as possible the inclosure of air bubbles, which would lead to flaws in the ware when burnt.

Kilns.—The regenerative gas furnace has begun to lend its valuable aid to this manufacture as well as to that of glass, and with marked advantage, including much saving of fuel and reduction of the number of pieces of ware spoiled in the firing. In this application of the furnace there is room for careful study of the distribution of the heat, dependent on the arrangement of the gas and air flues, in order to secure uniformity of firing throughout the contents of the kiln, varying as these do in form and size.

Decoration.—The feature of most note in this direction has of late perhaps been the extension of the transfer of *printed* patterns and designs, replacing to a large extent painting by hand. The method in question has long been in use for coarser purposes, but now much better work is done, and the production of effects in several colors by the well-known method of superposition—"color printing"—is commonly and extensively practiced. Metallic "lusters" too are applied with more successful effect than formerly, and the peculiar surface appearance, resembling that of mother-of-pearl, given by a lustrous bismuth glaze, has been introduced.

A NEW METHOD OF TAKING THE SPECIFIC GRAVITY OF LIQUIDS.

By H. SOMMERKORN.

THE apparatus required is a thin sided glass tube, divided into millimeters, and of from three to four centimeters in diameter, and a thin circular plate of exactly the same diameter, held by a string. The tube is closed with the plate, and the apparatus plunged into the liquid to be examined, pulling the plate against the tube with the thread. If the tube is plunged deep enough the hydrostatic pressure causes the plate to adhere. If the tube is then slowly raised upward in a vertical position, we reach a point where it merely hovers, and at the next it sinks. This point is easily observed. In the same moment the depth to which the tube is immersed in the liquid is read off on the scale.

If the specific gravity of the liquid $= s$, the superficies of the plate of glass or platinum $= a$, and its weight $=$ G, and the depth to which the tube was immersed in the liquid $= h$. At the moment when the plate is about to sink its weight, G, must be equal to the weight of a column of liquid of the height, h, the area, a, and the specific gravity, s, or a, h, s, which pressure, being equal to the weight of the plate,—

$$s = \frac{G}{a.h}.$$

The factor $\frac{G}{a}$ is the same for all measurements, h only being a variable quantity.—*Chemical News.*

TO CLEAN GUN-BARRELS FROM LEAD.—Pour in a little mercury, agitate it over the interior surface of the barrel, and pour it out again. The mercury will amalgamate the lead and remove it.

ON THE REMOVAL OF PARTICLES OF STEEL OR IRON FROM THE VITREOUS CHAMBER BY MEANS OF MAGNETS.

By EMIL GRUENING, M.D., Surgeon New York Eye and Ear Infirmary, Ophthalmic Surgeon to the Mt. Sinai and German Hospitals.

THE passage of a foreign body into the vitreous chamber is justly regarded as one of the most serious accidents to the eye. Encapsulation or tolerance of the foreign substance is of very rare occurrence, and, in the vast majority of cases, not only is the injured organ lost, but its fellow threatened by sympathetic ophthalmia. Generally speaking, the indications in cases of recent injury, complicated with the lodgment of foreign particles, are extraction of the body, and this failing, enucleation of the eyeball. Attempts at extraction by means of the instruments ordinarily employed (forceps, scoops, hooks, etc.) have so rarely been successful that some surgeons disregard the first indication and proceed at once to enucleate the injured eye. The most recent "Guide to Diseases of the Eye" (Nettleship) presents the status of the question as follows: "If it is certain that the foreign body has passed into the vitreous, whether through the lens or not, and whether by gunshot or not, it is scarcely ever worth while to attempt to save the eye."

McKeown, of Belfast, was the first to introduce a magnet into the vitreous for the purpose of extracting therefrom particles of steel or iron. (*British Medical Journal*, 1874.) Though he succeeded perfectly in removing the foreign body and in saving the eye, yet his recommendation of the magnet as an extractor did not procure for it a favorable reception. In a subsequent publication (*Dublin Journal of Medical Science*, 1876) he reports two additional cases, the one terminating in atrophy of the globe, the other in suppuration. Manz, who made an abstract of the first of these cases (Virchow und Hirsch, *Jahresbericht*, 1875), remarked that although the object of the operation had been accomplished, the body extracted, and the eye but slightly injured, still the magnet employed could not be considered a trustworthy instrument.

The reason, then, why McKeown's method did not receive the favor which it merited will be found in the circumstance that the particular magnetic instrument used by him was not suitable to the purpose. The magnet is described as being about eight inches long, one inch broad, one line thick, and tapering to a point at both extremities.

In 1879, Hirschberg (*Berliner Klinische Wochenschrift*, No. 46, 1879) successfully removed a piece of iron, 3 mm. long and 2 mm. broad, from the vitreous chamber, by means of an electro-magnet constructed for the purpose. The magnet consisted of a hollow cylinder of malleable iron, the two extremities of which were drawn out into long, fine points, like the branches of an iris forceps. The cylinder was surrounded by a coil which connected with a galvanic battery. Either of the poles of this electro-magnet easily sustained the weight of a small key, and attracted iron chips, 1 to 5 mm. long, at a distance of 1 to 4 mm.

Hirschberg's case excited much interest because it demonstrated clearly that a magnetic instrument, sufficiently delicate to be safely introduced into the eye, may still possess such powerful polarity as to extract particles of iron or steel from the vitreous without toil or trouble.

For some time past I have been experimenting with various forms of magnetic apparatus with a view of constructing an instrument that would concentrate the greatest possible magnetic polarity in the least possible dimensions. In my first trials I made use of well magnetized solid steel cylinders, one extremity of which had been filed into a long, slender, needle-like point. The latter, however, never exhibited sufficient magnetic polarity for the purpose in question, and, owing to the hard temper of the steel used in making good magnets, showed itself as brittle as glass, and broke upon the slightest provocation. Discarding the steel point, I had a long and delicate piece of malleable iron fitted into one extremity of the magnet. This slight alteration produced a more satisfactory instrument. Not only did the induced magnetism of the iron prove itself (*ceteris paribus*) more powerful than that of the steel point, but the fragility of the previously employed instrument had been removed also. In order to add still more to the magnetic polarity of the point, I joined several magnets into a bundle, thus making a powerful magnetic magazine. The principle of constructing such a magazine is old, the application of the apparatus for the removal of fragments of iron or steel from the vitreous chamber new. The two extremities of a number of magnetized steel rods placed parallel to and at a little distance from each other are fitted into iron caps, one of which is provided with a delicate point of malleable iron, 32 mm. long, 1 mm. wide, and 0·3 mm. thick. This point is powerfully magnetic, sustaining, with ease, a weight of 15 grammes. Chips of iron weighing from 1 to 50 centigrammes, when placed into the vitreous of recently enucleated animal eyes, are attracted toward the point at a distance of 1 to 5 mm., and withdrawn with the greatest facility. The instrument thus perfected *equals* Hirschberg's electro-magnet in efficiency, but *surpasses* it in simplicity of construction, convenience of form, and lowness of price.—*Medical Record.*

CATS FOR THE STUDY OF ANATOMY.

THE *Journal of Microscopy* says that it was practical as well as philanthropic on the part of Dr. Burt G. Wilder to suggest the more extended use of the cat for dissecting purposes. The anatomy of the cat is very much like that of man; the resemblance being closer than that of most other domestic animals. The viscera have nearly the same arrangement; the brain has the primary divisions, and even some of the fissures, which are found in man. Most of the cranial nerves may be easily discovered. The bones and many of the muscles can be identified from a knowledge of Gray or Quain alone.

There are many drawbacks to the successful study of anatomy upon the human body. The expense is considerable, the subject may be bad, progress is always slow, and there is, as a rule, very little systematic study in connection with the work. Dissection and examination of the viscera are greatly neglected, and yet they are the most important parts for the majority of students. It is very likely, therefore, that preliminary dissections of an animal so easily obtained and cared for as the cat would be of great help to the student. While studying under a preceptor or while pursuing any course of preliminary training he could easily occupy part of his time in such anatomical investigations. He would thus acquire a practical familiarity with the use of the knives, the appearance of the organs and tissues, and the names and general arrangement of most of the structures of the human body. A splendid collection of microscopic slides might be prepared from the cats of any given locality, and not least of the benefits to be derived from the formation of such a collection would be the increase of peace and quietness in the neighborhood.

DENTISTRY IN THE UNITED STATES.

THAT people are becoming aroused upon the subject of decayed teeth can be seen from the employment of twelve thousand dentists in our country (United States) who, according to the best authority we have, are annually packing into the cavities of the teeth no less than about half a ton of pure gold, costing about half a million dollars. It is estimated that there are at present (1879) in the United States about one hundred and fifty millions of dollars in (gold) coin. Now at the rate at which gold is being consumed in filling teeth, it will only require three hundred years to bury the present amount of gold in this country into graveyards. Besides this, there is probably in weight four times as much cheaper material, such as silver, platina, etc., used for filling cavities in teeth, which may be safely estimated at not less than one hundred thousand dollars, all of which in itself would amount to quite a large sum in the course of ten or twenty years ($1,000,000 to $2,000,000).

In the United States there are annually made about three million artificial or porcelain teeth, mounted on various kinds of plates, gold, platina, rubber, etc., which help to keep the busy fingers of the dental profession at work. What is more wonderful, however, is that not half of the people *who need it* avail themselves of their services.

From statistics taken in America, it has been ascertained that out of an average of about eighty people of all classes as we find them, only one can be found with perfect dental organs. All the rest are troubled more or less with decayed teeth. What an army of bandaged faces there must be pacing the floor in writhing torment every night, and yet some dentists wonder why the "Coltons" flourish while *they* do not; a query which it seems evident enough to me can be easily solved, and a change which is certain to be made when the profession shall take proper and liberal steps for a more general enlightenment of the masses of the people upon the subject of the importance of natural teeth.—*J. N. Farrar, in Dental Office and Laboratory.*

PETROLEUM IN PERU.

A correspondent of the New York *Times*, writing from Titusville, Pa., says that Mr. F. Prentice, one of the most widely-known oil operators in that region, has recently demonstrated the existence in Peru of the most remarkable oil territory yet discovered.

The oil lands of Peru are in the coast region. They extend from Cape Blanco to the Tumbez River, a distance of 120 miles. The tract is 60 miles wide, and contains 4,408,000 acres. Where the waves of the Pacific have worn away the rocks at places along the coast oil trickles out at low tide, and for 90 miles this outcrop may be followed along the ocean. The village of Zorritos is the present center of operations in the Peruvian region, which is almost entirely on one of the great estates of the country, known as the estate of Mancora. For many years the existence of asphaltum, both solid and liquid, has been known on this estate. The solid is found on the surface. From the sides of pits, dug to the depth of about 20 feet, the liquid asphaltum oozes. This mineral tar has an odor of pitch, and leaves no residuum when burned. This asphaltum was mined for the purpose of lining Pisco jars and other Peruvian crockery. The petroleum that gathered in these pits, after the discovery of oil in Pennsylvania had become known the world over, led Alexander Ruden, the agent of the Mancora estate, to experiment, with a view to test the oil-bearing capacity of the mineral-tar region. A. E. Prentice, a relative of F. Prentice, was then civil engineer to the Peruvian Government. Alexander Ruden petitioned the Government to send the engineer on a prospecting tour over the estate. Prentice began operations in the fall of 1863. A well was sunk in one of the asphaltum pits, which was nearly filled with crude petroleum. At a depth of 140 feet —60 feet below the ocean—a vein of oil was struck. The yield was small. Mr. Ruden's interest in the matter flagged, and further experiments were not made by him.

Mr. Prentice, the Pennsylvania oil operator, was informed of the prospects on the Mancora estate. In 1867 he paid Peru a visit. A well was put down near Zorritos. At the depth of 146 feet a volcanic formation was reached by the drill, and oil was found. The well pumped 60 barrels a day. A second well was put down. Oil was reached at a depth of 220 feet. The yield rapidly declined from 12 barrels to 7 barrels a day. Mr. Prentice was satisfied that the region would prove productive, but he held his own counsel. In 1876 he succeeded in securing control of the entire estate for the purpose of producing oil. In that year the second well, mentioned above, was drilled to the depth of nearly 500 feet. The tools struck a vein of oil-bearing sandstone and immediately sank 10 feet. This was the first finding of the sandstone. The strike was followed by a column of oil that filled the 6-inch casing, and was thrown 70 feet in the air. In attempting to control the great flow by inserting tubing in the well the inexperienced employes let the tubing drop to the bottom. The side caved in soon afterward and stopped the flow. The well is still plugged. Mr. Prentice says its capacity will be 1,000 barrels a day. Another well of his near the above has been in use for three years. It has never been torpedoed nor recupped. It yields 600 barrels a day. Mr. Prentice's experiments have proved that the deeper the wells are sunk the larger the yield is. At 600 feet he declares that a well in his Peruvian regions will pump 5,000 barrels a day. Back in the mountains some of his men have struck a vein of petroleum by merely digging a pit 28 feet deep. Several of these pits have been dug. Oil accumulates in them in paying quantities. Mr. Prentice has a refinery at Zorritos. Its capacity is 200 barrels. This he is now enlarging.

There were shipped from the Pennsylvania oil regions in 1878 1,085,615 gallons of oil to Peru, Chili, and Ecuador. Australia, China, and Japan also receive their millions of gallons from the same source. Peru is much nearer these countries than the United States. Mr. Prentice says that the region he is developing will more than supply these markets. Refined oil brings twenty-five cents a gallon in Peru and its neighboring States. There is very little wood or coal along the Pacific coast in South America. Fuel is very expensive, and is transported long distances. Coal is $15 a ton in large quantities. Mr. Prentice is introducing the use of crude petroleum for fuel. The people are beginning to use it largely. There are fifty English ocean steamers plying along the coast. They have contracted with Mr. Prentice to use crude petroleum instead of coal as fuel. They are erecting tanks for storing the oil at different landings. They are to pay $3 a barrel for the oil. The sugar refineries are also preparing to use the oil in place of coal. Mr. Prentice estimates that his oil territory in Peru will pay him a profit of $1,000,000 a year after his arrangements for developing it are perfected. He pays a royalty to both the Mancora estate and to the Peruvian Government for the monopoly that has been granted him.

THE SERAPEUM OF MEMPHIS.

A lecture was lately delivered by Professor A. Mariette, M.A., before the members of the Crystal Palace Company's School of Arts, Science, and Literature, London, on "The Remarkable Discovery of the Serapeum of Memphis," by the brother of the lecturer, now his excellency Mariette Pasha. After some introductory observations, the lecturer proceeded to say that M. Mariette eagerly volunteered to follow the track of Lord Prudhoe, afterwards fourth Duke of Northumberland, and of Tattan, to collect what Coptic and Syriac manuscripts had escaped the investigation of the two great English travelers, and after inquiry the French Government did not hesitate to accept his services. In August, 1850, the young *savant* left France for Egypt. In Alexandria he was surprised to find lying in the gardens of European residents a great number of sphinxes in limestone, covered with ancient Greek inscriptions. He was informed that they had all come from Sakkarah, the site of the ancient Memphis, and had been found in the desert, and he concluded that they could not but be connected with one of the marvellous avenues that led to the Egyptian sanctuaries. On reaching Cairo, Auguste Mariette placed himself in communication with Linant Bey, who volunteered to guide him in his expedition. Having visited the pyramids and explored the vast necropolis in the midst of which they stand, he proceeded to Sakkarah, and while awaiting the arrival of his friend he made a topographical survey of its necropolis. He purposed remaining a few days—he actually remained four years. He remembered a passage in Strabo, in which the old geographer, who was born sixty years B.C., spoke of the Serapeum of Memphis being placed at the entrance of the Lybian desert, and being constantly threatened with invasion from the sand. Soon afterward his foot struck against what proved to be a libation table, sculptured in honor of Osiris-Apis, which is now to be seen in the Louvre, and he concluded that the tombs of Apis, which must contain so many scientific treasures, could not be far off, and he determined to seek for the Serapeum at all risks. The search for manuscripts was given up, and his credit and future career were at stake. The Egyptian Apis, as old as the worship of the divine bull, had two homes, in one of which he lived under the name of Apis, the other, where he reposed after his death, under the name of Osorapis or Serapis. He was prepared to find the latter plundered of its treasure, as it was by the early Christians, but the plunderers had, perhaps, spared the archæological and historical treasury, which was far more valuable than any amount of silver and gold. He commenced his labors in the desert with a score of fellahs, some with pickaxes, some with baskets to carry off the sand. A second sphinx soon rewarded their labor, and others followed to the number of twenty-one. They formed a few of those which constituted an avenue of sphinxes in the middle of a vast necropolis. The avenue wound its crooked way between vast funereal monuments. The labor entailed might be gathered from the fact that while the sphinxes first discovered lay at a depth of 12 feet below the surface the others were found at a depth of between 60 and 70 feet. At last the 135th sphinx was brought to light at a spot where the avenue turned to the right at an angle of 85°. The work was pushed on vigorously in spite of enormous difficulties, which the lecturer detailed at some length. One day eleven of the laborers were buried under an avalanche of sand, and were with difficulty extricated. The headmen of the neighboring villages ordered that all supplies of food should be withheld, and the fellahs were forbidden to work for him, but in spite of these and various other difficulties, including orders from the highest authorities in Cairo to desist, which he disregarded, he still persevered. After the 141st sphinx had been secured, a spacious dromos, paved with fine flagstones, was discovered. It was in shape a semicircle, decorated with eleven Greek statues of poets, philosophers, and lawgivers, and it stopped the explorer's way. He determined on a new departure, and soon came on a chapel, bearing the royal cartouche of Neelanbo I. of the 30th dynasty, the last but two of the indigenous Pharaohs. The image of Apis stood there, a welcome indication to the young explorer that he was on the right track. But the chapel stopped his way and he had to take a new direction. He did so to the west, and two other chapels were discovered; one in the Egyptian, the other in the Greek style. The latter was empty; in the former stood a statue of Apis, in stone, with the solar disk before his horns. The statue, before which Alexander the Great, Cleopatra, and Cæsar must have passed, and which must have witnessed the last solemn rites of the funerals of Apis, was now an object of admiration at the Louvre. Along both sides of a paved causeway ran a wall 6 ft. high, built of huge blocks, upon which, as upon a pedestal, stood colossal statues of fantastic animals. A peacock, 6 ft. high, carrying a little Genius, a gigantic cock, a lioness, a panther with a serpent's tail, a Cerberus—all led by children—a phœnix with a woman's head, lions with strange faces; all samples of the mystic symbolism of Egypt as conceived by the Greek mind. The work was carried on in most trying circumstances. All sorts of impediments were thrown in the way of the indefatigable archæologist, but they were got over. High officials arrived from Cairo with prohibitions, which he contrived to disregard. When his labors were found to be crowned with success, the Egyptian authorities claimed their fruit; but the monuments he had discovered he contrived to have conveyed to Alexandria and shipped to France. European international jealousies and Turkish cupidity conspired together against the young antiquarian, but with unflagging enthusiasm he continued his course, and after a lengthened period the French Government interfered on his behalf and sent him a large and welcome remittance. The details of the further excavations were narrated by the lecturer, who added that during the night of the 12th of November, 1851, the last loads of sand were removed, and a long gallery was opened to view. The explorer attempted to enter, but his light was extinguished by foul air. At last he was enabled to enter and stood in the tomb of Apis. He beheld walls covered with tablets with thousands of texts and with divine images: a treasure of historical documents which have no parallel in the world. It was not until February, 1852, that a less intolerant *régime* enabled the excavators to work at all efficiently. To the 513 monuments which had been already forwarded, over 2,000 others were safely sent to Alexandria. The sarcophagi discovered were of polished granite, each cut out of a single stone, and were 10 ft. in height and 13 ft. in length, and weighed upwards of 60 tons. It was difficult to realize by what mechanical contrivance such enormous masses of stone were transported to their resting places from the far distant quarries. When the entrance to the great tomb was effected the finger marks of the Egyptian who had closed up the last stone of the wall were still visible in the cement, and on the sand of the floor was still to be seen the impression of the naked feet of the workmen who 3,230 years before had deposited the deified Apis in his tomb. This and other tombs yielded many valuable and beautiful specimens of jewelry which now enrich the collection of the Louvre.

SUPPOSED CHANGES ON THE MOON.

Two years ago those astronomers who take especial interest in observing the moon were startled by the announcement by a German astronomer, Dr. Hermann J. Klein, of a remarkable change on the lunar surface, due to the sudden formation of a great, black crater over three miles in diameter. This new formation was stated to have appeared in a comparatively open region of the moon, near the great valley rill of Hyginus. A full account of the early history of this supposed case of a real physical change on the moon will be found in the *Popular Science Review* for April, 1879. The great interest of this announcement lies in the fact that according to the opinion generally held by astronomers, all active change on the lunar surface had long ere this died away; though, on the other hand, there have been few, if any, of these astronomers who have devoted much time to the study of the lunar surface, who have not strongly expressed their dissent from this opinion. It so happens that this region near Hyginus has been especially well studied, and had been frequently drawn, and not only in the past, but within very recent times. It was therefore at once recognized that this reported change, if confirmed, would afford a crucial confirmation of the view that real changes of great magnitude were still occurring on the lunar surface. If this were so, then at any moment the lunar surface might present us with the opportunity of studying a great volcanic eruption, covering the surface for miles with lava and filling the surrounding region with clouds of ashes. Even if no volcanic eruption were to take place, at any moment a grand landslip might occur, presenting a magnificent spectacle as some great mountain mass rolled crashing down a slope, plowing up the surface before it and raising enormous clouds of *débris* as peak after peak fell with terrific energy into the depths below. There could be no doubt that the establishment of a single case of actual physical change on the moon would increase manifold the charm and value of lunar observations.

In the article in the *Popular Science Review* for April, 1879, the history of this supposed new formation terminates with the close of February of the same year. At that period it was still uncertain whether any new object had really made its appearance in this portion of the lunar surface. That a number of observers had seen something in this region was unquestionable; but then others had failed to recognize anything of the kind. The only two experienced lunar observers who had seen this region under proper illumination were Dr. Klein, its discoverer, and Prof. Julius Schmidt, the great selenographer of Athens. Little was known about the observations of the latter, and the former had only seen it properly on one night. Others, including more than one who were thoroughly familiar with the region, had been completely baffled in their attempts to see this region by the extraordinary run of bad weather. At the epoch, therefore, of the article in the *Popular Science Review* for April, it had been found impossible to arrive at any definite conclusion.

Everything has now changed, and at the present time it is possible to arrive at a definite conclusion about the remarkable formation first observed by Dr. Klein, and named "Hyginus N," by the authority of the Selenographical Society. During March and April it was observed and drawn by Mr. Neison, who had paid particular attention to the delineation of this portion of the moon, and who at once recognized it as a great, conspicuous object which was certainly not visible when he had drawn this region on many occasions between 1871 and 1876. Mr. N. E. Green also observed this formation on the same occasion as Mr. Neison, and their drawings published in the *Selenographical Journal* for June completely confirm one another. It was also well seen and drawn by Dr. Klein, and likewise by Messrs. Durrad, McCance, and Sadler, and by MM. Gaudibert, Borefoy, and Sluyaert. Later on, towards the end of the year and beginning of this, it was again seen and drawn by Messrs. Neison, Green, Capron, Common, Noble, and Durrad. Moreover, as most of these observers were astronomers practiced in observing and drawing the lunar surface, their drawings were found to be perfectly accordant, and left no room for uncertainty as to the exact position of this remarkable formation. A series of micrometric measures, by Mr. Neison, fixed its place on the moon as + 9° 5′ of selenographical latitude and + 6° 47′ of selenographical longitude.

There can be, therefore, no longer any doubt about the actual existence in this region of a great, black, crater-like formation, nearly as large and quite as conspicuous as Hyginus itself, and far too distinct for it to be possible to overlook it whilst drawing the minuter objects in the region all round it.

Now there can also be no doubt that, on numerous occasions prior to 1876, this region was examined and drawings made by many observers, including Schröter, Lohrmann, Mädler, Gruithuisen, Kinau, Schmidt, and Neison, yet though they delineate many difficultly visible details, none drew or even saw this great black crater-like object which now stands so conspicuously in the very midst of this region. The only conclusion to be drawn seems to be that at this period it did not exist. If this be so, it must have been formed between 1876 and 1877. It is therefore the first thoroughly authenticated instance of a real physical change on the moon. What this change really means must be left for further observation to elucidate.—*Pop. Sci. Rev., April*, 1880.

ANIMALS INJURIOUS TO THE SUGAR CANES IN BRAZIL.

By E. Guignet.

An account of M. Capanoma's process for destroying the terrible Saüba ants. Some liters of carbon disulphide saturated with sulphur are poured into the galleries of these depredators, and the solution is fired by means of a fuse. The ants are killed by the explosion or by the fumes evolved. —*Moniteur Scientifique.*

AGRICULTURAL ITEMS.

An English grape grower stopped the profuse bleeding of a thrifty young vine by forming a sort of hard cement over the cut ends by repeated dusting at short intervals with Portland cement.

A New York farmer kills the cabbage worm by sprinkling the plants with common black pepper from an ordinary tin box—a pound to one hundred and fifty plants—sometimes previously sprinkling with soap suds from the week's washing.

Bran or ground feed, says the *National Live Stock Journal*, is best fed to cows upon moistened cut hay. By mixing with the hay, all will be eaten together and raised and remasticated. But if it is not fed with cut hay, it should be fed dry and in small quantity each time.

The largest hog in the country is a Poland China, four years old this spring, lately on exhibition at Junction City, Kan. His length is seven feet; girth of neck, six and a half feet; girth of chest, seven and one-eighth feet; girth of center, eight feet; width across the hip, thirty inches; and weighs 1,532 pounds.

A correspondent of the *Country Gentleman* recommends clearing away the surface earth from around the trunks of fruit trees, down to the branch roots, and giving the trunk and upper surface of the roots a good coat of whitewash with salt in it. He says it will greatly improve the appearance of the foliage.

Cow peas, which have long been cultivated at the South, are beginning to be recommended to Northern farmers as a food for cattle. They are said to be better feed than green corn, and just as much can be got from the same space without impoverishing the soil. They are sown in drills, any time after spring frost, for fodder. Poultry as well as cattle are fond of them.

An Indiana farmer tried four different fertilizers for melons—poultry droppings, well rotted cow manure, barn manure, and old bones (gathered upon the farm and reduced by placing them in alternate layers with ashes the previous year), mixing all liberally in the different hills, which were eight feet apart each way, and says he raised the greatest crop of melons he ever saw from the hills fertilized with bone dust.

HOW WHEAT GROWS.

THE first stalk (plumule) of wheat that comes up is the only one the grain itself produces. In the spring, when the wheat plants begin to spread, each stalk begins to throw out tillers, which come from a ring encircling it, about half an inch below the surface. Every tiller, like its parent, has a ring and follows suit in the same way, and so on, *ad infinitum* to four, five, and sometimes many generations—if I may use the term—provided the alluvial elements in the soil are abundant enough. A branch or limb of a tree is not a tiller, but corn suckers, water sprouts on fruit and other trees, coming from the roots, are tillers. Now, if your correspondent will pull up a stool of wheat in April and wash it carefully, he will find every root and stem attached, first to the parent, then to the next, and so on, like bees to their queen, or ants to one another, when they bridge the streams in South America. One grain of wheat, when given the proper plant food and cultivation, and when permitted to carry out its habit, will cover from 9 to 25 square inches of ground. Wheat is gregarious; it likes company of its own kind, but not that of another. I know instances where bearded wheats have almost entirely choked out and killed smooth varieties when sown together. Rye and oats, chess, cockle, cheat, and some early weeds will destroy almost any wheat field. Farmers would do well—far better—to sow genuine seed, all of one kind, without a single grain of any other, either of wheat or foreign seed. Wheat is so sensitive that it will not tolerate even other wheats, especially bearded, to say nothing about weeds.—*Cultivator.*

ATHABASCA WHEAT FIELDS.

AT the last session of the Dominion Parliament a subcommittee was appointed to consider the feasibility of running a line of steamships from York Factory, Hudson Bay, to Liverpool, and a great many witnesses—Hudson Bay officials chiefly—were examined on the subject. The matter was then given in charge of Col. A. S. Dennis, the surveyor general, who was instructed to take additional testimony and make a report to the House this session. Colonel Dennis has collected a vast quantity of evidence, and in his report, which was to be laid before Parliament shortly, he will recommend the equipment of a steamer to make the voyage by way of experiment, and this, no doubt, will be done. The principal difficulty in the way of colonizing the Canadian northwest is the want of means of export for the wheat from there. Even when the Canada Pacific Railway is built, wheat grown in the fertile valley of the Saskatchewan will have to be hauled the distance of nearly two thousand miles ere it reaches tide water at Montreal or Portland, while the vast wheat growing belt extending from the Saskatchewan northward beyond the Churchill river to Lake Athabasca will not be tapped at all by the railroad. A line of steamers running from York Factory to Liverpool during the season of navigation, which generally lasts ten weeks, would bring those wheat fields as near to the British markets as Chicago is. The distance by the traveled seaway from the factory to Liverpool is 2,966 geographical miles, or about 100 miles nearer than the port of New York, while the distance from the factory inland to the center of the great northern wheat district is about equal to the distance from Chicago to New York. For two centuries the Hudson Bay supply boats have voyaged from Stromness, in the north of Scotland, to York Factory, and in all that time they have lost only two vessels, the Prince Arthur and the Prince of Wales, both of which ran ashore on Mansfield's island, at the entrance of Hudson Bay. No lives were lost, and the cargoes were ultimately saved. The route is from Stromness via Cape Farewell and through Hudson Strait into the bay. Col. Dennis will point out that if the proposed steamship line could be run successfully, the wheat markets of the world would soon be revolutionized. There are, according to his report, which is founded on the results of the most recent surveys, no less than 260,000,000 acres of land in the Canadian northwest, not only capable of growing wheat, but singularly well adapted for it. Supposing that only one third of this region were put under wheat, and that the average was not more than fifteen bushels to the acre, the annual production would exceed 1,200,000,000 bushels—enough to feed the whole civilized world.

The Hudson Bay Co.'s records show that navigation on Hudson Bay route is open from the end of June to the beginning of October. Their ships sail from Stromness and sometimes from the Clyde about the 1st of June, and pass through Hudson Strait immediately after the clearing of the ice. York Factory is at the mouth of the Nelson, a river of the first class, and the outlet of all the rivers and lakes included within the basin of Lake Winnipeg, extending from the Rocky Mountains on the west to within one hundred miles of the shores of Lake Superior on the east. The river is navigable for hundreds of miles to boats of light draught, and it is believed that by the expenditure of half a million dollars, it can be made navigable for propellers equal in size and tonnage to those on the St. Lawrence route, for upwards of two hundred miles, including tributaries. This would bring the great wheat belt within four hundred miles of navigation, and make it three hundred miles nearer Liverpool tidewater than the elevators at Chicago. Moreover, the Churchill, the Saskatchewan, and other rivers, are navigable for hundreds of miles to flat bottomed Hudson Bay boats, carrying from eight to ten thousand bushels, so that the cost of carrying the wheat from these northern fields direct to York Factory would certainly not exceed the cost of carriage from Chicago to New York or Montreal. Aside from the waterways, however, a railroad four hundred miles in length from York Factory southwestward would bring the wheat belt in direct ocean communication with Liverpool. The valley of the Nelson, and almost the whole of the tremendous region which it drains, have a singularly mild and humid climate. The cold winds from Hudson Bay and the frozen ocean to the north are not felt thirty miles inland from York Factory, while the effect of the warm, moisture-laden winds from the Pacific, which are deflected by the combined influence of the earth's rotation and the northern winds, is very perceptible. Surveyors who have just returned from the region, say that the trees were in full bloom early last June, and that by the middle of June the banks of the rivers and the country behind were teeming with animal and vegetable life. The Nelson River district, in fact, is the winter migrating ground for deer and buffalo. York Factory is only three hundred and seventy-two miles distant from the northern end of Lake Winnipeg, and a railroad between those points, supposing navigation to be impossible, would bring the whole eastern end of the Red River region in direct communication with the sea. Prof. Hind, who has devoted much attention to the subject, is convinced of the feasibility of the scheme, and is of opinion that the proposed route would be the ocean highway for the export of products of all the country north of the Missouri.

Of course the whole scheme hinges on the ocean route from York Factory to Liverpool; if that is impossible for grain-carrying steamers, the whole project falls to the ground. Col. Dennis has made careful inquiry into this branch of the subject. The Hudson Bay boats are crafts of about eight hundred tons, and they make one trip from Stromness with supplies to the factory and return with furs between the 1st of June and the 1st of October. On the western side of Davis Strait, along the shores of Frobischer Bay and Cumberland Strait, there are inexhaustible deposits of lignite coal, and a coaling station could be established at the entrance of Hudson Strait, or, for that matter, at the factory itself. Col. Dennis is satisfied from his examination of the Hudson Bay books, that steamers of one thousand tons could make two round trips in the season. The wheat, say, of the harvest of 1879, could be conveyed by water up to the 15th of October, and by the four hundred miles of railroad after that to York Factory and stored there, pending the arrival of the first fleet on the 15th of June. The Government, acting on Col. Dennis' recommendation, will doubtless grant $50,000 for an experiment during the coming season. Prof. Hind says that if the scheme can be worked and the products of the northern wheat belt landed at Liverpool by this route, wheat growing for export will be no longer profitable for the Western States.—*Northwestern Miller.*

CALIFORNIA RAISINS.

IN a recent issue of the San Francisco *Chronicle*, a correspondent, writing from San Bernardino, gives an interesting account of the rise and progress of the raisin industry of that region. It was begun by P. S Russell and G. D. Carleton, of Riverside, who procured 50,000 cuttings of the muscat of Alexandria. The soil best adapted to raisins is a light gravelly or sandy loam, such as occurs in all the foot hills and mesa lands of Southern California.

The vines are usually set eight feet apart each way, which allows 688 vines to the acre. Some more experienced raisin growers recommend that the space between every fourth and fifth row be twelve to fourteen feet, as this allows greater facility for drying, and also leaves sufficient room for driving through the vineyard.

The planting season is from January until the latter part of March. It is preferable to plant as early as possible, as the cuttings then get the advantage of the rainy season. Should the ground be dry, it is customary to irrigate the vines as soon as planted, in order to set the soil around them and prevent them from drying out. Good raisins cannot be grown without irrigation, as wet land is too cold and heavy to produce perfect fruit. During the first summer the vines require to be watered once in three to once in six weeks, dependent upon the capacity of the soil to retain moisture. Bearing vines require more moisture than young ones, but should not be watered after the fruit begins to color, as it makes it watery and insipid, and destroys the quality of the raisin. Experience has shown that the shorter the stocks of the raisin vines the larger the fruit and the more prolific the yield, and they are kept short and stocky, some of the vines in our best vineyards not being more than a foot to eighteen inches in length. It is customary to cut off all the canes, leaving but three to five, according to the size of the vine. On each cane from two to four buds are left. During the summer care is taken to keep down the suckers, and all superfluous sprouts are broken off as they appear. This is done every two or three weeks, and by this means the whole strength of the vine is forced into the grape. Some also thin out the fruit on the vines where they are too heavily laden. Immediately after pruning, the vineyard is thoroughly plowed, and irrigating ditches are left on either side of the rows of vines. After each irrigating a cultivator is run through them in order to loosen up the soil and prevent a growth of weeds. This is repeated until the growth of the vines prevents further cultivation.

The curing season begins about the middle of September. It is then that the grapes attain a peculiar rich amber color, which denotes that they are sufficiently ripe for picking. As all the fruit does not ripen at once there are two and three pickings in the season, which is continued until November. The clusters of grapes are carefully picked up by the stems, care being taken not to touch the fruit, as it knocks off the bloom and spoils its appearance. They are then placed upon wooden trays, two feet by three, each tray holding about fifteen pounds of green fruit. When filled, the tray is placed between the vines, where it is left for ten or fifteen days, by which time the fruit has dried to a dark purple, when they are turned by placing an empty tray on the top of the full one and turning them over, and they are left for ten or twelve days more to complete the drying process.

When the fruit is dry the trays are gathered up and the dust that may have blown on the raisins is carefully blown off, and the fruit is put in what are known as sweating boxes. These are the same size as the trays, and from twelve to fourteen inches in depth. The fruit is slid off the tray into these boxes until they are filled, when they are covered and stored in a cool place for at least two weeks. The sweating process converts the dried grapes into raisins, gives them uniformity of color and quality, and toughens the stems so that they can be handled.

When the sweating is completed the raisin is ready for packing for market, and in this great care is required. The imperfect fruit is thrown out and the rest sorted into two qualities, which are then packed into whole, half, or quarter boxes. The whole boxes are 18¼ in. long, 9 in. wide, and 4¾ in. deep, and hold 20 pounds. The half and quarter boxes are the same size, but shallower, and hold ten and five pounds respectively. In filling, the grapes are first weighed, and then carefully placed in a filler. This is a wooden frame a little smaller inside than the inside of the boxes. It is made to fit on the box, and has a bottom-piece of galvanized iron, which slides in grooves. This is lined with white paper, and the raisins are carefully arranged, bunch by bunch, until it contains five pounds. A block of wood 1½ in. thick, covered on the bottom with tin, and known as a "follower," is then placed on the top, the tin bottom being first dampened to prevent adhesion, and the whole is placed under a screw, and left under pressure for a short time. The filler is then removed, placed on the top of the box to be filled, the bottom withdrawn, and the solid cake of raisins drops into place. These are covered with the ends of the paper, which are left sufficiently long to fold over, and the process is repeated until the box is filled.

San Bernardino is especially favorable for the production of raisins, and those packed at Riverside are already attaining a national reputation. The great superiority of this section lies in its abundance of water for irrigation, the hot weather which prevails during the drying season, and its freeness from fogs and moisture, enabling a perfect grape to be grown and insuring rapidity and perfection in curing. Some idea of the profits of this industry may be gathered by a statement published by Mr. Henderson, of Riverside, of the cost and profit of two acres of vines which he has at that place. Of course, with a small vineyard it is possible to bestow more care and greater pains on the crop than could be done on a larger scale, but the statement is sufficient to show what can be done with careful cultivation:

400 boxes London layers, at $2 per box	$800 00
75 boxes layers, at $1 50	112 50
Total	$912 50

EXPENSES.

Boxes and paper	$63 25	
Pruning and watering	18 00	
Cultivation	15 00	
Picking	35 00	
Packing	40 00	
		$171 25
Net profit		$741 25

This vineyard was planted in 1877, rooted vines one year old being used. The crop of 1878 was 140 boxes, which were sold at $1 50 per box. The cost of starting a vineyard may be given as follows, the calculation being based upon an acre:

680 cuttings	$2
Preparing land	5
Cultivation, first season	5
Total	$12

Add to this the cost of land, which varies from $25 to $200 per acre, according to quality and location, and the cost of water, if it has to be purchased separately from the land, and you have the cost of a vineyard. The first season is all outlay, the second year will yield some fruit, and the third year will put it on a paying basis, and the vines will give about an average of ten pounds of green fruit. At five years the vineyard should be in full bearing, and the vines then will average about twenty pounds each, which, when dried, will give about six or seven pounds of raisins per vine. Picking is paid for by the piece, five cents per tray being the ruling price. It is done to a great extent by women and boys. Pruning will cost about $3 50 per acre, but as there is always a good demand for cuttings this becomes an additional source of profit.

It was not until 1878 that it was practically demonstrated that San Bernardino could produce raisins that would bear comparison with the imported article, but the success with which that year's crop was manipulated drew the attention of the dealers to them, and the whole crop of Riverside was purchased in advance last year, being, for that settlement alone, some $30,000.

INSECTS, AND HOW TO FIGHT THEM.

CUT WORMS.

WHERE cut worms are troublesome in the field, a very old and at the same time a very good remedy is to entrap them in holes made near the plants, or hills, if in the cornfield. An old rake handle, tapered at the end so as to make a smooth hole five or six inches deep, or more, will answer very well for this purpose. In the morning the worms that have taken refuge in these holes may be crushed by thrusting the rake handle into them again, and the "trap" is set for the next night. It is always well in planting to make provision for the loss of a stalk or two by cut worms or other causes, as it is easier to thin out than to replant.

MAY BEETLES.

These are the perfect insects of the white grub, so destructive to lawns and sometimes to meadows. A French plan for destroying, or rather catching, the cockchafer, a very similar insect, is to place in the center of the orchard after sunset an old barrel, the inside of which has been previously tarred. At the bottom of the barrel is placed a lighted lamp, and the insects, circling around to get at the light, strike their wings and legs against the tarred sides of the barrel, and either get fast or are rendered so helpless that they fall to the bottom. Ten gallons of beetles have been captured in this way in a single night.

SLUGS.

English gardeners place handfuls of bran at intervals of eight or ten feet along the border of garden walks. The slugs are attracted to the bran, and in the morning each little heap is found covered with them. The ground is then gone over again, this time the operator providing himself with a dustpan and small broom and an empty bucket, and it is an easy matter to sweep up the little heaps and empty them, slugs and all, into the bucket. In this way many hundreds have been taken in a single walk, and if a little salt and water be placed on the bottom of the bucket the slugs coming in contact with it are almost instantly destroyed.

ANTS.

When these insects are troublesome in the garden, fill small bottles two-thirds with water, and then add sweet oil to within an inch of the top; plunge these into the ground near the nest or hills to within half an inch of the rim, and the insects coming for a sip will get into the oil and perish, as it fills the breathing pores. The writer once entrapped in a pantry myriads of red ants in a shallow tin cover smeared with lard, the vessel having accidentally been left in their track. Another means of entrapping them, suggested to me by Professor Glover many years ago, is to sprinkle sugar into a dampened sponge near haunts to attract the insects. When they have swarmed through the sponge it is squeezed in hot water, and the trap is reset until the majority of the insects are killed.

APHIS.

A remedy for plant lice upon the terminal shoots of rose bushes (or similar hardy plants), said to work like a charm, is as follows: Take four ounces of quassia chips and boil for ten minutes in a gallon of soft water. Take out the chips and add four ounces of soft soap, which should be dissolved in it as it cools. Stir well before using, and apply with a moderate-sized paint brush, brushing upward. Ten minutes after, syringe the trees with clean water to wash off the dead insects and the preparation which would otherwise disfigure the rose trees.

SCALE.

A French composition for destroying scale insects, plant lice, etc., on fruit and other trees, is as follows: Boil two gallons of barley in water, then remove the grain (which may be fed to the chickens), and add to the liquid quicklime until it approaches the consistency of paint. When cold, add two pounds of lampblack, mixing it for a long time, then add a pound and a half of flowers of sulphur and a quart of alcohol. The mixture is applied with a paint brush, first using a stiff-bristle brush to remove moss, etc. It not only destroys the insects, but gives the bark greater strength.—*Prairie Farmer.*

[Continued from SUPPLEMENT No. 231, page 3686.]

FOREST TREES OF NORTH AMERICA.

By CHARLES S. SARGENT, Arnold Professor of Arboriculture in Harvard College, Special Agent Tenth Census.

192. *Platanus racemosa*, Nutt. Sacramento Valley to Southern California and Arizona. Wood said to be more valuable than that of the last species. A large tree, sometimes 100 feet in height.

193. *Platanus Wrightii*, Watson, Proc. Am. Acad. x. 349. In Southeastern Arizona, near the San Pedro River. A large tree.—Wright.

JUGLANDACEÆ.

194. *Juglans Californica*, Watson, Proc. Am. Acad. x. 349. *J. rupestris*, var. *major*, Torr. in Sitgr. Rep. 171, t. 16. Valley of the Sacramento River, and in the neighborhood of San Francisco, California; eastward through Southern Arizona, New Mexico; and in Sonora. A large shrub, or sometimes a tree 40 to 60 feet in height.

195. *Juglans cinerea*, L. *J. oblonga*, Mill. *J. cathartica*, Mich. f. (Butternut. White Walnut.) Northern shores of Lakes Erie and Ontario, Northern Vermont; south to Northern Alabama, and west to Missouri and Arkansas. Rare at the South, except along the mountains. Wood brownish, light, soft, easily worked, susceptible of a beautiful polish, very durable; extensively used in cabinet-making. A small or medium-sized tree; a tincture used as a cathartic is prepared from the inner bark, which also yields a valuable dye.

196. *Juglans nigra*, L. (Black Walnut.) Southern portions of the Province of Ontario, Western Vermont; south to Florida; west to Eastern Nebraska, Kansas, the Indian Territory, and Eastern Texas. Wood dark brown, light, soft, easily worked, susceptible of a beautiful polish, very durable; its specific gravity 0·577; more extensively used in cabinet-making and for gun-stocks than that of any other American tree. A tree 60 to 80 feet in height, with a trunk 4 to 6 feet in diameter; of the first economic value. Rare at the east; most common in the valley of the Mississippi and its tributaries; but now everywhere becoming scarce.

197. *Juglans rupestris*, Engelm. Bot. Sitgr. Rep. 171, t. 15. Devil's River, Western Texas; Southern Arizona, and Walnut Grove, Arizona. A shrub, or small tree, sometimes 20 feet in height.

198. *Carya alba*, Nutt. (Shell-bark Hickory. Shag-bark Hickory.) Canada; York County, Maine, to the upper districts of Georgia, and Northern Alabama; west to Eastern Nebraska, Kansas, and Arkansas. Wood very heavy, strong, tenacious, elastic, furnishing the most valuable firewood of the Atlantic forests; extensively employed in the manufacture of agricultural implements, carriages, baskets, etc.; its specific gravity 0·839. A medium-sized tree, 50 to 70 feet in height, with a trunk 2 to 5 feet in diameter; of the first economic value, producing, next to the Pecan, the most highly esteemed of North American nuts.

Carya microcarpa (Nutt. Gen. ii. 221), will probably, on further investigation, be found not specifically distinct from this species, with which it occurs from Pennsylvania and Delaware, south to the upper districts of Georgia.

199. *Caraya amara*, Nutt. *Juglans angustifolia*, Lam. Dict. iv. 504. *Juglans amara*, Michx. (Bitter Nut. Swamp Hickory. White Hickory.) Canada and Northern Vermont, south to Florida, and west to Eastern Nebraska, Kansas, and Arkansas. Wood with the general characteristics of the last species, but lighter, and in every way less valuable. A small or medium-sized tree; generally in low grounds; the nut thin-shelled, exceedingly bitter, not edible.

200. *Carya aquatica*, Nutt. *Juglans aquatica*, Michx. (Water Hickory.) North Carolina, in the low districts, to Florida and Alabama; and in Southern Arkansas? Wood probably of little value in comparison with that of the other species of the genus. A small tree, 30 to 50 feet in height; in low swamps.

201. *Carya myristicæ formis*, Nutt. *Juglans myristicæformis*, Michx. (Nutmeg Hickory.) "South Carolina, at Goose Creek" (Michaux), "Berkeley District" (Ravenel), and in Western Louisiana. A small tree; in swamps or low ground.

202. *Carya porcina*, Nutt. *Juglans glabra*, Wang. *Juglans porcina*, Michx. f. *Juglans obcordata*, Willd. *C. glabra*, Torr. and Gray. (Pig Nut. Brown Hickory.) Canada to Southern Florida, west to Eastern Nebraska, Kansas, and Eastern Texas. Wood very similar to that of *Carya alba*. A large or medium sized tree; in dry uplands.

203. *Carya sulcata*, Nutt. (Western Shell-bark Hickory. Thick Shell-bark Hickory.) Lancaster County, Pennsylvania, and west to Eastern Kansas. Heart wood lighter colored, but similar to that of *Carya alba*. A large tree in rich bottom lands. Rare east of the Alleghany Mountains; more common in the valley of the Mississippi River; the large thick-shelled nuts sweet and edible.

204. *Carya tomentosa*, Nutt. (Mocker Nut. White-heart Hickory.) Canada and Northern New England, south to Florida; west to Eastern Nebraska and Arkansas. Wood resembling that of the last species. A medium-sized tree; in dry uplands, or more rarely along the banks of streams in deep and often submerged soils; a fine variety, bearing large, thin-shelled, valuable nuts, is known in the valley of the Genesee River, New York, as "King Nut."

MYRICACEÆ.

205. *Myrica Californica*, Cham. and Schl. Sacramento River, California, north to Washington Territory. A shrub or small tree, "sometimes attaining a height of 30 to 40 feet, with a diameter at base of two feet or more."—Watson, Bot. Cal. ii. 81, ined.

CUPULIFERÆ.

206. *Quercus agrifolia*, Nee. (Encino.) California, near the coast, principally south of San Francisco, and occasionally reaching Mendocino County. A large tree, with a stout, low trunk, often 8 to 12 feet, sometimes 16 to 21 feet, in circumference (base of Monte Diablo—Brewer), and with a spread of branches of 120 feet" (Engelm. in Bot. Cal. ii. 98, ined.); also occurring as a small shrub.

207. *Quercus alba*, L. (White Oak.) Southwestern Nova Scotia, Southern New Brunswick, Canada in the latitude of Quebec (rare), and west along the Manitoulin Islands, and the northern shore of Lake Michigan to Wisconsin; south to Northern Florida, and west to Western Missouri, Arkansas, and Eastern Texas. Wood light-colored, strong, heavy, elastic, durable; its specific gravity 0·662; largely employed in ship-building, construction of all sorts, cabinet-making, cooperage, for which purpose and basket-making it is preferred to all other American woods; also very largely in the manufacture of agricultural implements, carriages, etc., and for railway ties, piles, posts, and fuel. A large tree, 60 to 80 feet in height, with a trunk 6 to 8 feet in diameter; of the very first economic value, and superior to all other North American oaks in the quality and value of its wood.

208. *Quercus aquatica*, Nutt. (Water Oak.) Maryland, and Sebastian County, Arkansas, south to Florida and Eastern Texas. Wood tough, but probably of little value. A small tree, 30 to 50 feet in height; in low ground, along streams and ponds.

209. *Quercus bicolor*, Willd. *Q. Prinus*, var. *tomentosa*, Michx. *Q. Prinus*, var. *discolor*, Michx. f. (Swamp White Oak.) Canada, Northern Vermont, and Wisconsin, south through the Northern States, and along the Alleghany Mountains to Georgia; west to Eastern Nebraska and Arkansas ("bottoms of the Washita River."—Lesquereux. Wood said to equal that of the White Oak. A large tree, with a trunk sometimes, although rarely, exceeding 30 feet in circumference ("Wadsworth oak," Geneseo, N. Y.); in swamps and along streams, in deep alluvial soil.

Var. Michauxii, Engelm. Trans. St. Louis Acad. iii. 390. *Q. prinus palustris*, Michx. *Q. Michauxii*, Nutt. From Delaware and Southern Illinois, south to Northern Florida. In low ground.

210. *Quercus Catesbæi*, Michx. (Turkey Oak. Scrub Oak. Forked-leaf Black Jack.) North Carolina to Florida and Southern Alabama. A small tree, rarely exceeding 25 feet in height; only in sandy barrens near the coast.

211. *Quercus cinerea*, Michx. *Q. phellos*, var. *cinerea*, Spach. (Upland Willow Oak. Blue Jack.) North Carolina to Florida and Eastern Texas, near the coast. A small tree, rarely exceeding 30 feet in height; in sandy barrens; the bark yielding a yellow dye.

212. *Quercus chrysolepis*, Liebm. *Q. fulvescens*, Kellogg *Q. crassipocula*, Torr. (California Live Oak.) California, in the coast ranges and along the western slopes of the Sierra Nevada. A large tree, 3 to 5 feet in diameter; or, at higher elevations, reduced to a shrub [Var.? *vacciniifolia*, Engelm. Trans. St. Louis Acad. iii, 393. *Q. vacciniifolia*, Kellogg.]

213. *Quercus coccinea*, Wang. (Scarlet Oak.) Eastern Massachusetts, southward near the coast, in light sandy soils; and in Minnesota.—Engelmann. The range of this species, often confounded with the forms of *Q. tinctoria* with deeply-cut leaves, is still obscure, and especially deserves the attention of botanists.

214. *Quercus densiflora*, Hook and Arn. *Q. echinacea*, Torr. California, "from the Santa Lucia Mountains (Palmer), through the coast ranges, and especially among the Red Woods, to the Shasta region. "A pretty large tree; 50 to 60, or rarely 80, feet high (Santa Cruz Mountains—Brewer), and a foot or two in diameter; often a mere shrub, 5 to 7 feet high."—Engelm. in Bot. Cal. ii. 99, ined.

215. *Quercus Douglasii*, Hook and Arn. (Mountain White Oak. Blue Oak.) California, "in dry foothills of the coast ranges, from Monte Diablo and Mount Oso to Sacramento Valley. "It resembles a middle-sized White Oak of the Eastern States in its size, pale, scaly bark, and quality of its timber. The largest tree seen by Professor Brewer has a circumference of 7 feet."—Engelm. in Bot. Cal. ii. 95, ined.

216. *Quercus dumosa*, Nutt. *Q. berberidifolia*, Liebm. *Q. acutidens*, Torr. California, "common in the cañons and on the arid slopes of the coast ranges from San Diego to San Francisco Bay; the variety (var. *bullata*, Engelm.) in the Santa Lucia Mountains (Brewer) and northward to Lake County (Dr. Torrey)."—Engelmann in Bot. Cal. ii. 96, ined.

217. *Quercus Emoryi*, Torr. *Q. hastata*, Liebm. (Comal County, Texas, through Southern New Mexico to Rocky Cañon, Arizona (Rothrock). A small tree, or often a shrub.

218. *Quercus falcata*, Michx. *Q. elongata*, Willd. *Q. discolor*, var. *foliata*, Spach. *Q. triloba*, Michx. *Q. falcata*, var. *triloba*, DC. (Spanish Oak.) New Jersey to Missouri, and south to Florida and Eastern Texas; most common in the Southern Atlantic States, where in the middle district it is the most prevalent forest tree. Wood reddish, coarse-grained, not durable, of little value; somewhat employed in cooperage. A large tree, often 80 feet in height, with a trunk 4 to 5 feet in diameter; its bark rich in tannin.

219. *Quercus Garryana*, Dougl. *Q. Neei*, Liebm. Vancouver Island and British Columbia, south to San Francisco Bay, near the coast. Wood hard, brittle, probably of little value. A large tree, 70 to 100 feet in height; extending farther north than any oak of the Pacific forest.

220. *Quercus heterophylla*, Michx. *Q. aquatica*, var. *heterophylla*, DC. *Q. phellos*×*coccinea*, Engelm. Trans. St. Louis Acad. iii. 385, 391, 541. New Jersey, near Camden, Haddonfield, Mount Holly, and in Cape May County; Delaware, near Townsend Station and Wilmington; North Carolina (M. A. Curtis in Herb. Canby); Eastern Texas (E. Hall). A small tree, of uncertain origin.

221. *Quercus hypoleuca*, Engelm. *Q. confertifolia*, Torr. Bot. Mex. Bound. 207 [not HBK]. "Sanoita Valley, Southern Arizona, at 7.000 feet altitude (Rothrock, 1874); also found in the San Francisco Mountains. "A very conspicuous and as yet little known species, which Dr. Rothrock found 30 feet in height and 1 foot in diameter."—Engelm. in Wheeler Rep. vi. 251.)

222. *Quercus imbricaria*, Michx. (Shingle Oak. Laurel Oak.) New Jersey, south along the Alleghany Mountains, and in the upper districts to Georgia; west to Wisconsin and the Indian Territory. Wood hard and heavy, but probably of little value except as fuel. A small tree, sometimes 50 feet in height. Most common west of the Alleghany Mountains.

223. *Quercus Kelloggii*, Newberry, Pacif. R. Rep. vi. 260, 6. *Q. rubra*, Benth. Pl. Hartw. 337. *Q. tinctoria*, var. *Californica*, Torr. *Q. Sonomensis*, Benth.; DC. Prodr. xvi². 62. California, in the coast ranges, and along the western slopes of the Sierra Nevada, reaching a higher elevation than any other of the California oaks. A large tree, or often at high elevations reduced to a small shrub.

224. *Quercus laurifolia*, Michx. *Q. aquatica*, var. *laurifolia*, DC. *Q. phellos*, var. *laurifolia*, Chap. (Laurel Oak.) North Carolina, in the middle and lower districts, south to Florida. A large tree.

225. *Quercus lobata*, Nee. *Q. Hindsii*, Benth. Bot. Sulph. 55. *Q. Ransomi*, Kellogg, Proc. Calif. Acad. i. 25? California, "common throughout the State, in the plains or in the foothills; or in the southern part of the State somewhat higher in the mountains. A majestic tree, sometimes 15 to 20 feet in girth, 100 feet high, and with a wider spread of branches (Brewer), which often hang down to the ground. The wood is said to be brittle."—Engelm. Bot. Cal. ii. 96, ined.

(*To be continued.*)

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